AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Reg. U. S. Pat. Off.
Established 1902

Vol. 62 No. 23

Contents

Automotive Industries is published every Saturday by
CHILTON CLASS JOURNAL COMPANY
Chestnut and 56th Streets, Philadelphia, Pa.

Cable Address .... Autoland, Philadelphia
Telephone .... Sherwood 1424

OFFICES
New York—U. P. C. Bldg., 239 W. 39th St., Phone Pennsylvania 0080
Chicago—5 South Wabash Ave., Phone Central 7045
Detroit—710 Stephenson Bldg., Phone Northway 2090
Cleveland—1140 Guardian Bldg., Phone Main 6860
Los Angeles—433 Petroleum Securities Bldg., Phone Westmore 9084

Controlled by United Business Publishers, Inc., 239 West 39th St., New York; ANDREW C. PEARSON, Chairman, Board of Directors; FRITZ J. FRANK, President; C. A. MUSSELMAN, Vice-President; F. C. STEVENS, Treasurer.

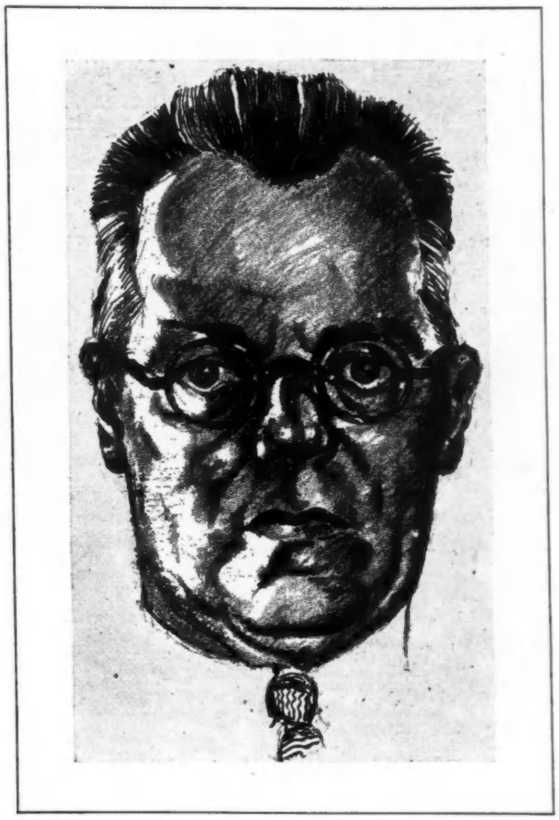
SUBSCRIPTION RATES: United States, Mexico, United States Possessions, Canada and all countries in Postal Union, $3.00 per year; Foreign, $6.00 per year. Single Copies 35c.

Member of the Audit Bureau of Circulations
Member Associated Business Papers, Inc.

Automotive Industries—The Automobile is a consolidation of the Automobile (monthly) and the Motor Review (weekly), May, 1902; Dealer and Repairman (monthly), October, 1903; the Automobile Magazine (monthly), July, 1907, and the Horseless Age (weekly), founded in 1895, May, 1918.

AUTOMOTIVE INDUSTRIES

VOLUME 62 JUNE 7, 1930 NUMBER 23



Coker Fifield Clarkson

May 11, 1870—June 4, 1930

Coker Fifield Clarkson

1870 — 1930

COKER FIFIELD CLARKSON, for twenty years secretary and general manager of the Society of Automotive Engineers, died at his home, Scarborough-on-Hudson, N. Y., on Wednesday, June 4, at the age of 60. Clarkson came to the S. A. E. from the Mechanical Branch of the Association of Licensed Automobile Manufacturers in 1910, when the Society had about 400 members, and under his efficient management it grew until now the membership exceeds 7000. The continued growth, the general prosperity, and the high standing of the Society among technical organizations are conclusive proofs of his managerial abilities, and the Society at its recent Summer Meeting, in recognition of his services, elected him its first honorary member.

Coker Clarkson was born in 1870 at Des Moines, Ia., where his father, Gen. James C. Clarkson, was publisher of the *Des Moines Register*. General Clarkson later came East and served as chairman of the Republican National Committee and as Surveyor of the Port of New York. The younger Clarkson graduated from Philips Exeter in 1888 and from Harvard University in 1894, but he stayed at Harvard for two years more, taking a post-graduate course in the Harvard Law School. In 1896 he was admitted to the bar in Philadelphia and was connected with a law firm in this city for two years. He then removed to New York where he joined a law firm well known at that time and later opened his own law office, specializing in technical, corporation and patent cases.

Clarkson's connection with the automotive industry dates from 1905, when he became secretary of the Mechanical Branch of the Association of Licensed Automobile Manufacturers. He remained with the Association until 1910, when the Mechanical Branch was discontinued. During part of this time he served the Association also as publicity manager and assistant general manager. While with the A. L. A. M. Clarkson edited the Mechanical Branch Bulletin and the A. L. A. M. Digest of Current Technical Literature. During this period he became acquainted with most of the leading engineers in the automobile industry,

When the Mechanical Branch was discontinued all of its records were conveyed to the Society of Automobile Engineers and Clarkson became the secretary and general manager of this organization. It took over the standardization work which had been started by the Mechanical Branch, and this, from the standpoint of the automobile industry at least, was for a long time its most important activity.

With the accession of Clarkson to the S. A. E. its activities were at once greatly expanded. Permanent headquarters were established, a paid staff was engaged, and the programs of the annual and summer meetings from that time on were arranged on a much more ambitious scale.

The Society of Automotive Engineers as it exists today is largely Coker Clarkson's work, and from 1910 on, his career had been closely tied up with the history of the Society. During the war Mr. Clarkson served as a member of the Automotive Products Section of the War Industries Board, of the Council of National Defense, and of the International Aircraft Standards Board. In 1917 he was secretary of the Truck Committee of the Quartermaster's Department, U. S. A., which designed the various standardized military trucks used by that Department.

Mr. Clarkson had been ailing since the annual meeting and was unable to attend the Summer meeting at French Lick. Recently he had improved considerably to all appearances, and as late as last Sunday he had expressed to friends that he expected to be back at his office within a few days. His sudden death came as a great shock to those near him. Mr. Clarkson is survived by his widow and one daughter.

S. A. E. SUMMER MEETING

Society is Urged To Aid in Framing State Motor Codes

Society should assume part of industry's legislative responsibility, summer session at French Lick is told

By LESLIE PEAT

WITH a quarter of a century of achievements behind it, the Society of Automotive Engineers at its annual summer meeting last week at French Lick Springs, Ind., was challenged to assume leadership in the field of legislation. One of the founders of the Society and several of its most active members called attention to the need of the engineering body to cooperate with other groups in the industry to offer guidance to legislators who frame the laws of the various states.

Col. H. W. Alden, whose automotive experience dates back 36 years, pointed to the changing conditions in our economic life and concluded that the industry today needs to be protected from restrictive legislation as much as it has needed the constructive work of the technical committees of the S.A.E. during the past 25 years. He urged upon the Society, the Council particularly, that it reach out a little more in contracts with legislative activities of other organizations.

"I venture to assert," he said, "that legislatures of the various states will welcome honest and intelligent cooperation, and it seems to me that the most important thing we can do as a society is to get together with legislators and work out with them their problems before restrictive codes and laws are crystalized. I don't agree with some members of the Society that we should keep our fingers off these matters. I think we should cooperate a great deal more than we have ever thought of doing."

Although the discussion over legislative features that confront the motor bus and motor coach business indicated that there is a wide difference of opinion as to how the industry should approach the problems of codes, it developed that state laws pre-

For a Technical Automobile Organization

It has been suggested to us that there is a field for an organization of automobile engineers in the United States, and that the time has come when such an organization could be effected here. The need of such an organization is making itself felt, and there is no reason why it should conflict in any manner with the various other automobile organizations. The National Association of Automobile Manufacturers occupies itself solely with the commercial questions of the automobile business, and represents entirely the commercial end of the industry. On the other hand, now that there is a noticeable tendency for automobile manufacturers to follow certain accepted lines of construction, technical questions constantly arise which require for their solution the cooperation of the technical men connected with the industry. These questions could best be dealt with by a technical society founded, say, on the same lines as the American Society of Mechanical Engineers. The field of activity for this society would be the purely technical side of automobilism, and in other matters it could work in harmony with the clubs and the N. A. A. M. Meetings could be held at specified intervals, at different places, and papers read and discussed on subjects relating to the branch of engineering the society represents.

We shall be glad to accord space to any views on this subject our readers may wish to express.

This editorial, which was written by P. M. Heldt, engineering editor of Automotive Industries, started the movement to organize the Society of Automotive Engineers. It appeared in the June 4, 1902, issue of Horseless Age

Vincent Bendix, president, Bendix Aviation Corp., who was nominated for president of the Society of Automotive Engineers for 1931 at the Summer Meeting held last week at French Lick, Ind.

sent problems today as acute and less amenable to solution than most technical engineering difficulties.

L. R. Buckindale, Timken Detroit Axle Co., has found it practically impossible to correctly design trucks for low-pressure tires under the restrictions found in 24 states in the Union. He offered the suggestion that state vehicle codes be left in the hands of engineers employed by the states. These men, he believes, could develop basic vehicle specification codes with the aid of the Bureau of Standards and other agencies and would administer them for their respective states.

A. J. Scaife, White Motor Co., in supporting a contention raised by F. C. Horner, General Motors, that there is today too much restrictive legislation, said that legislative bodies now have a whiphand over industry, and held that any approach to the problem should be made with future requirements in mind. Both these men said that the way for alterations in codes should be kept open at all times.

Technical sessions of the summer meeting this year were particularly well attended as compared with previous years. Fewer formal papers were read, allowing more time than has been usual to informal discussions.

The Diesel engine session showed clearly that automobile engineers are very interested in all of the developments that are taking place in this field of powerplant engineering. It was reminiscent of the early days of the industry, when practically every development was experimental and when members of the Society had to depend upon engineering reports of their colleagues for information about new practices and design. In the discussion which followed the papers by H. D. Hill and C. L. Cummins, it was pointed out that it was a mistake to believe that fuel suitable for Diesels would be available at 5 to 6 cents a gallon if this type of engine really came into wide use. The present low price of this fuel was said to be due to overproduction.

Mr. Cummins also referred to the fuel problem and said that if there was any difficulty in getting suitable fuel in sufficient quantity from the refiners, the Diesel engine industry could get its fuel directly from the producers, as the engine would run satisfactorily on crude oil of some types.

Research work on vapor lock by Drs. O. C. Bridgeman and H. S. White, of the Bureau of Standards, has progressed far enough to indicate what should be avoided in fuel line design. Increase in diameter at some point in a fuel line, or its corollary, a restriction, are outstanding causes for this phenomenon, it was brought out in papers read at the aircraft engine session.

Introducing the factor of psychology into the problem of riding comfort, F. A. Moss, George Washington University, and Ammon Swope, Purdue University, sounded a new note in a perennial discussion. Fatigue, measured from a sampling of automobile riders, is largely a matter of nerves, it would seem, and therein may lie some adequate answer to "What is a comfortable ride?" This study was sufficiently competent to bring a number of engineers to the realization that the actual bodily fatigue is not by any means the only factor in fatigue of passengers, although the number of cases used was limited.

Electrically-operated brakes were described by John Whyte, who, with A. W. Frehse, gave papers at the brake session. The latter largely consisted of a description of the Houck brake, developed by the General Motors Corp. Mr. Whyte stressed the need to so design a car as to increase the ability of the front end of the vehicle to resist increased torsional forces.

In a paper on passenger car gearsets, Herbert Chase discussed the newer three and four-speed transmissions with quiet next-to-top gear. Automotive engineers were generally agreed that in at least two respects gearsets are in need of improvement, namely, ease of shifting and quietness of operation. While most changes in gearset design in recent years have been along these lines, other changes have been of a more radical nature, and there exists a diversity of opinion with regard to them. The most important of these relates to the number of changes of gear. This is a somewhat involved problem as it affects the type and size of engine to be employed, the rear-axle gear ratio, the design of other units, such as the clutch, propeller shaft and universal joints, the weight of the car, and its salability.

Research work on the volatility of fuels, started 10 years ago by the society, has been progressing under the steering committee of the Cooperative Fuel Research and was discussed in three papers by Clarence S. Bruce, W. C. Baurer and O. C. Bridgeman and Miss E. W. Aldrich, Bureau of Standards. The engine acceleration phase of this research has been completed, and was summarized by Mr. Bruce.

Alex Taub, Chevrolet Motor Co., offered reasons for comparatively low-speed engines in two papers. His thesis was that if the output of a given engine were increased, as by increase of the compression ratio, speed of operation, etc., although the cost of manufacture per horsepower of the engine would be decreased, the necessity for using premium fuel would increase operating costs.

Past Presidents of the S.A.E.

1905-7 Andrew L. Riker*
1908 Thomas J. Fay
1909 Henry Hess*
1910 Howard E. Coffin
1911 Henry Souther*
1912 Henry F. Donaldson
1912 Herbert W. Alden
1913 Howard Marmon
1914 Henry M. Leland
1915 William H. Van Dervoort
1916 Russell Ruff
1917 George W. Dunham
1918 C. F. Kettering
1919 Charles M. Manly
1920 Jesse G. Vincent
1921 David Beecroft
1922 B. B. Bachman
1923 Herbert W. Alden
1924 Henry M. Crane
1925 Harry L. Horning
1926 Thomas J. Litle, Jr.
1927 J. H. Hunt
1928 W. G. Wall
1929 W. R. Strickland

* Deceased.

Alex Taub, development engineer, Chevrolet Motor Co., whose paper on powerplant economics was a feature of the engine session of the S.A.E. Summer Meeting

Holds Low-Speed Engine

While manufacturer's cost per hp. ratios and operating speeds, the crease, Alex Taub states in paper de

By P. M.

THE paper on Powerplant Economics presented by Alex Taub of the Chevrolet Motor Co. to the S.A.E. summer meeting at French Lick last week, was essentially a brief for the low-speed automobile engine. Mr. Taub pointed out that if the output of a given engine is increased, as by increase of the compression ratio, speed of operation, etc., although the cost per horsepower of the engine to the manufacturer will be decreased, the operating cost may be increased, because the user may have to burn premium fuel, and the fuel mileage may actually be less because of the engine being operated in the detonating range.

The low-speed performance of the engine is likely to be adversely affected by the change, and to compensate for this the engine revolutions per mile of travel may be increased, which also reacts unfavorably on the fuel economy. By carrying through a program of increased piston displacement per dollar, the performance is improved throughout the range. Engines for operation at very high speeds require manifolds of large sectional area, and such manifolds, since they result in poor distribution, interfere with satisfactory low-speed operation.

When the horsepower of a given engine is increased, the rate of heat rejection is increased. Therefore, the exhaust valves are subjected to greater heat stresses, and this is particularly so if some of the cylinders receive lean mixtures, as leanness reduces the rate of combustion and the after-burning effect increases the valve temperature. If the displacement of the engine is increased, relatively smaller manifolds can be used, which will stabilize induction, cut down precipitation, add "jamming effect" due to the greater velocity, generally improve part-load operation and reduce the amount of excess fuel required for acceleration. Mr. Taub said a marked economy advantage had been actually determined for cars equipped with relatively large, low-speed engines, as compared with smaller high-speed engines.

The heat stresses on the exhaust valves are also increased by the special timing required for high-speed operation, particularly the early exhaust opening. Specific bearing loads due to inertia forces increase very rapidly with engine speed, since the inertia itself varies as the square of the speed, so that the PV factor upon which frictional losses depend, varies as the cube of the speed. Counterweights are used to offset the effect of inertia on bearing loads, but unfortunately they lower the speeds at which torsional vibration gives trouble.

An interesting point brought out by Mr. Taub was that in Colorado (with its high altitudes) piston-ring life is abnormally short if the mixture ratio is not corrected for altitude. An increase in altitude causes the mixture to become richer and the carbon formed by the burning of these rich mixtures evidently causes the rings to stick.

Mr. Taub referred to other evils connected with high-speed operations, such as the increase in engine

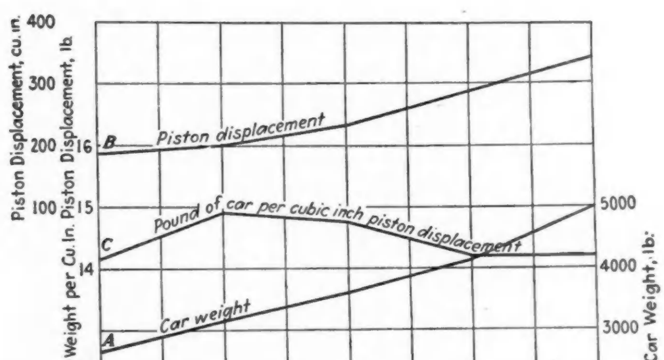


Fig. 1—Variation of design factors with price

C. W. Spicer, vice-president of the Spicer Manufacturing Co., who was nominated treasurer of the S.A.E. for 1931

Has Economic Advantage

decreases with higher compression user's maintenance charges in-livered at S.A.E. Summer meeting

Heldt

noise. In order to show what is being done today in respect to speed of passenger car engines and the powering of passenger cars, the author had analyzed data of numerous 1930 model passenger cars and of their performance on the General Motors Testing Ground. None of the 30 odd cars in the list were of General Motors make and the cars were divided into five classes which (the author explained) corresponded roughly to the Chevrolet, Pontiac, small Buick, large Buick and Cadillac. The figures of each price class were averaged. From Fig. 1 it will be seen that the weight increases nearly uniformly with the price, and the piston displacement also increases with the price, the rate of increase, however, being not constant but increasing with increased price. The result is that the specific weight on a displacement basis is lowest in the lowest and highest-price classes and higher for some of the intermediate classes.

Fig. 2 shows two curves which the author refers to as potential durability curves, namely r.p.m. per m.p.h. and piston travel in feet per mile; one curve referred to as a potential economy curve (cu. ft. displacement per car-mile), and one referred to as a potential performance curve (cu. ft. displacement per ton-mile). These curves would indicate that the longest life might be expected from cars in the lowest price class; that there is a rapid drop in life to the next price class and that from there on the life characteristics remain about the same or improve slightly. The potential overall (fuel) economy naturally decreases as the price (and the size) of the car increases, while the potential performance (acceleration and speed) increase as the price increases.

Performance tests on the Proving Grounds showed that the fourth class (cars in the same price class as the large Buick) has best acceleration and hill-climbing performance; performance of the fifth class slightly poorer; that of the first three classes considerably lower, these three classes all ranking about the same as regards performance. Actual road (fuel) economy at various speeds also was plotted, and decreased rather rapidly as the car price (car size) increased.

In concluding his paper Mr. Taub emphasized that if foundry, forge and machine shop methods and costs are carefully looked after, it is often possible to considerably increase the displacement of the engine without adding materially to production cost.

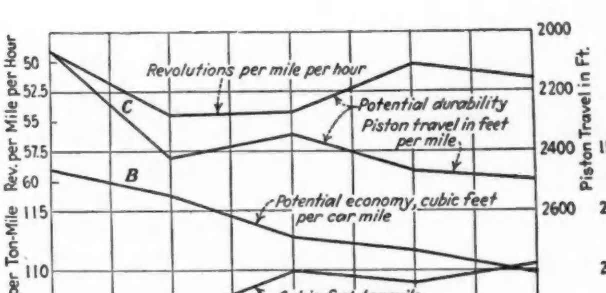


Fig. 2—Variation of potential performance, economy and durability with price

In the discussion A. L. Clayden referred particularly to the author's preference for large-bore, short-stroke engines and said that two eminent engineers of the industry, Henry M. Crane and F. W. Lanchester, had always favored a small stroke-bore ratio and the latter in a paper published some 20 years ago had come to the conclusion that the highest all-around efficiency would be obtained with the stroke and bore about equal. He could not help feeling that taxation methods abroad had had their influence in lengthening the relative strokes and that the long-stroke engine had been introduced here from Europe some 20 years ago when our designers were still under European influence to a considerable extent.

TABLE I—GENERAL EFFECTS OF THE ADDITIONS STUDIED ON THE PROPERTIES OF BRONZES

Addition		Wear Resistance (Ambler Test)	Frictional Force	Resistance to Pounding, at			Resistance to Impact (Izod)	Brinell Hardness
Element	Per Cent			70 Deg.	350 Deg.	600 Deg. Fahr.		
Zinc	4	No appreciable effect. Decreased with alloys of low lead and high tin	Not affected	Increased	No appreciable effect	No appreciable effect	Tendency to increased toughness at all test temperatures	Slightly harder
Phosphorus	0.05	Increased in most cases	Not affected	Increased	Little effect	Pronounced decrease	No definite change	Tendency toward slight increase
Nickel	2	Decreased	Slightly increased	Marked increase	Slight increase	Decreased in many cases	Increased with low lead-content; decreased with appreciable lead	No appreciable change
Antimony	1	Increased in most cases	Increased at 70 deg. Fahr.	Increased	Increased	Increased	Decreased about 30 per cent	Slightly harder in most cases

H. E. Maynard said that the "results per dollar" factor to which the author referred must be interpreted from the standpoint of the ultimate consumer. What applied to the low-priced car did not necessarily apply to the high-priced car. The many refinements which had been made in engine design in the past, such as improved types of bearing, aluminum-alloy pistons, force-feed lubrication, etc., certainly had made it practicable to operate at higher speeds. The tendency to weight reduction, moreover, was not confined to automobile design, and as an example he mentioned the recent development of Diesel engines suitable for aircraft use where formerly it was always thought necessary to make Diesel engines extremely heavy.

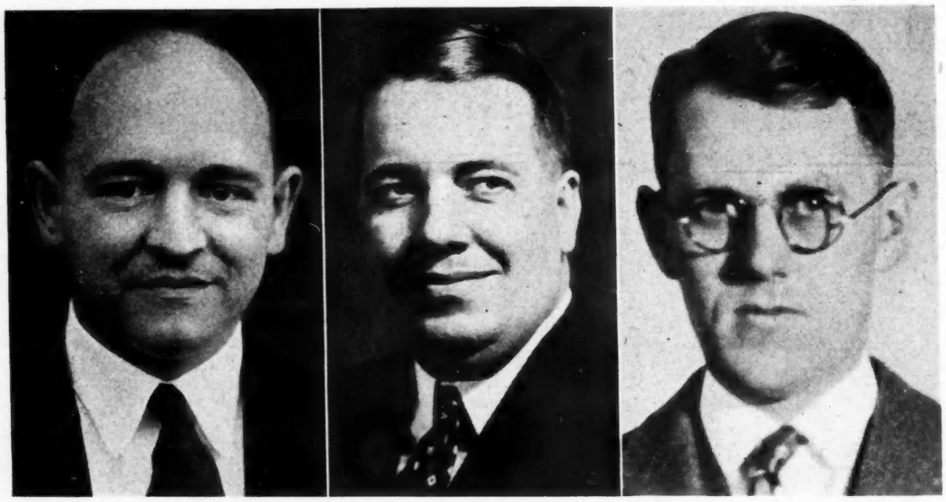
"High engine speed makes for low weight," Mr. Maynard said. If the engine displacement is increased the car weight is increased, and this is contrary to a slogan much used by engineers, viz., "Make a pound of material work harder." Outstanding performance, which is so much appreciated by the owner, should not be sacrificed unduly for other considerations. Moreover, the extreme speed of which an engine is capable is demanded of it only a small fraction of the time, and the recent introduction of transmissions with silent next-to-top gear has made it practical to run so-called high-speed engines at very reasonable speeds the greater part of the time.

A number of other speakers, including F. P. Kishline, assistant motor engineer, Graham-Paige Motors Corp., also took issue with Mr. Taub.

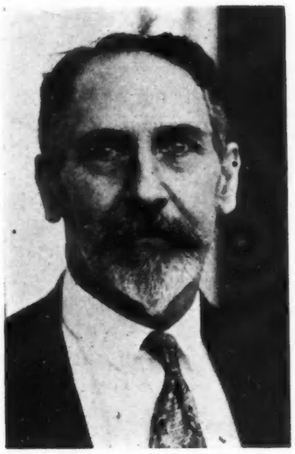
In the paper on Bearing Bronzes with the Addition of Zinc, Phosphorus, Nickel and Antimony, by E. M. Staples, R. L. Dowdell and C. E. Eggenschwiler, a report was made on one particular phase of the general study of bearing bronzes which has been in progress at the Bureau of Standards, with the cooperation of the Bunting Brass & Bronze Co., for over two years, namely, the effects of different impurities on the properties. The properties studied were wear resistance, resistance to repeated pounding, resistance to single impact, and hardness. The wear tests were made without lubrication in an Amsler machine, each bronze specimen being tested against a standard steel specimen made of 0.93 per cent carbon steel, oil-hardened, which has about the same surface hardness as the case-hardened steels usually used for shafts running in bronze bearings. The effects of the impurities on the different properties are summarized in Table I.

A second paper by Mr. Taub, on Combustion Chamber Progress, was a review of the work done by H. R. Ricardo, W. A. Watmough and R. N. Janeway in the improvement of combustion chamber forms with a view to making practicable the use of higher compression ratios.

Nominated as Vice-Presidents



Frederick K. Glynn, American Telephone and Telegraph Co., John A. C. Warner, Studebaker Corp., and Arthur Nutt, Curtiss Airplane and Motor Co. (left to right), were among the vice-presidents nominated at the Summer Meeting of the S. A. E. held at French Lick Springs last week. Other nominations included George W. Lewis, National Advisory Committee for Aeronautics, William F. Joachim, Westinghouse Electric and Manufacturing Co., and Carl Parsons, Parsons Co.



Dr. F. A. Moss
George Washington
University

Riding Qualities Analyzed from Psychological View

Scientific measurement of body fatigue encountered difficulties through lack of funds, Dr. Moss reports to S. A. E.

By
ATHEL F. DENHAM

UNIVERSITIES and their laboratories have played a big part in automotive development in the past. That they are potentially a big factor in further development was indicated at the body session of the summer Society of Automotive Engineers meetings which closed May 29 at French Lick Spring, Ind.

Riding comfort and wind resistance formed the main topics of the session at which three papers by university professors were discussed. The first topic was tackled in two different ways, by Dr. F. A. Moss, of George Washington University, in a progress report entitled "Bodily Steadiness—An Index of Riding Comfort," and G. C. Brandenburg and Ammon Swope of Purdue University in a paper, "The Psychology of Riding Quality." "Wind Resistance" was the title of the paper presented by F. W. Pawlowski, of the University of Michigan.

The difference in the method of approach on the question of riding comfort as indicated by the two papers on the subject was particularly interesting in view of the present difficulty encountered by the Society in securing sufficient capital to carry on its investigations, through Dr. Moss, on this topic. As will be remembered from previous reports in *Automotive Industries*, Dr. Moss' work is based on the measurement of actual bodily fatigue caused by driving an automobile, measurements being taken both before and after driving. The wobble-meter used for the measurement of fatigue has been further developed, largely through the cooperation of the Bureau of Standards, and was described in some detail by Dr. Moss.

The main difficulty in securing money to carry on this work seems to be traceable to the fact that automobile companies are unwilling at this time to contribute toward the carrying on of scientific research without the ability to avail themselves immediately of information derived during the progress of this work. A suggestion offered by W. S. James, Research Engineer, Studebaker Corp., might offer a solution to this problem. His suggestion was to the effect that wobble-meters, or designs for them as at present constituted, be supplied to automobile manufacturers, enabling the latter to carry on the work, obtaining both the scientific data to be correlated by the riding

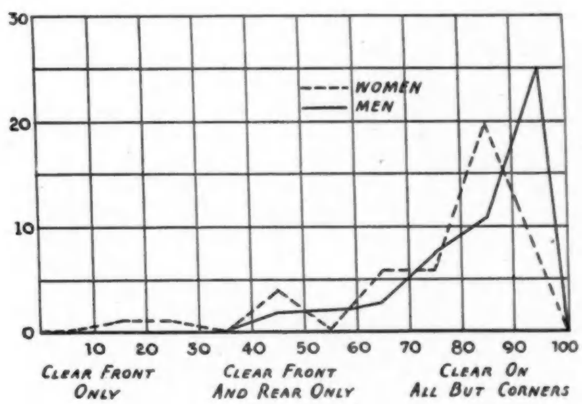


Fig. 14a—Desirable Vision

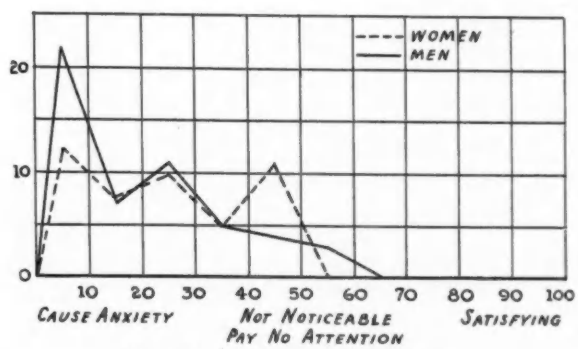


Fig. 13a—Unidentified Noises

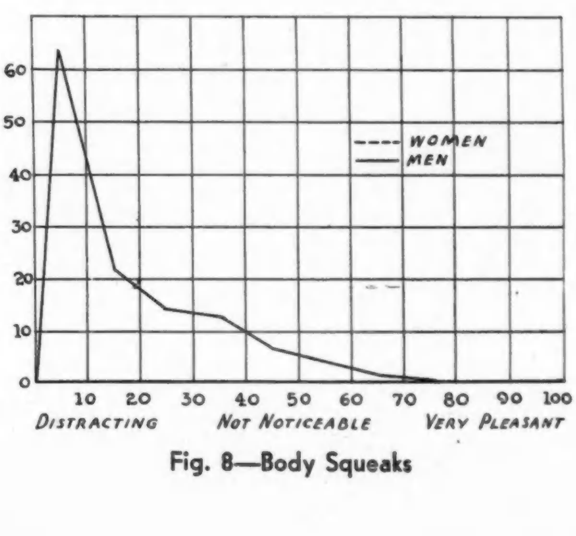


Fig. 8—Body Squeaks

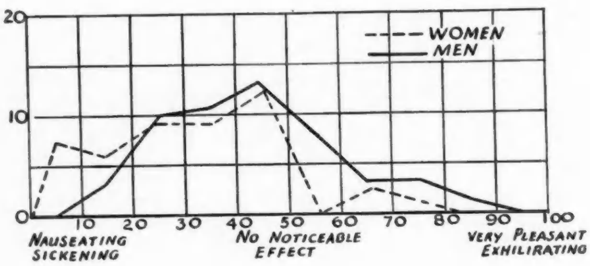


Fig. 3a—Skidding

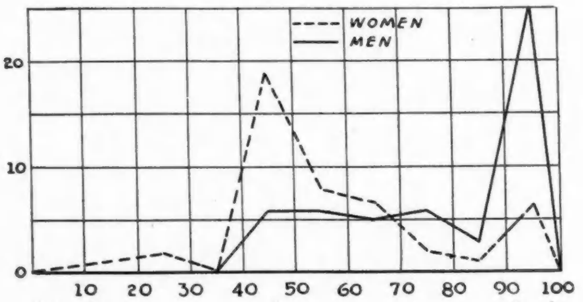


Fig. 5a—Acceleration Preferred

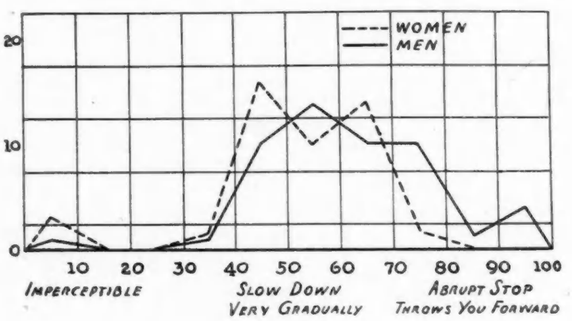


Fig. 6a—Retardation

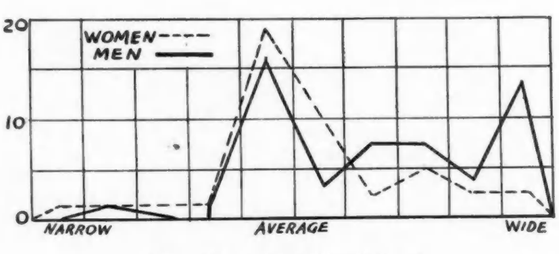


Fig. 21a—Depth of Seat

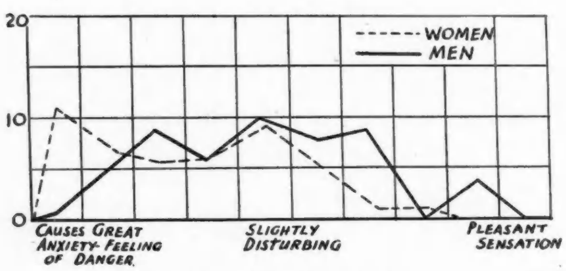


Fig. 2a—Swaying Motion

Indices of riding comfort in graphs. The vertical scale represents the number of observers, while the horizontal scale indicates the magnitude of factors in riding qualities

comfort sub-committee, and also data which can be applied immediately, as obtained in revising automobile designs.

R. W. Brown of Firestone Tire & Rubber Co. agreed with Mr. James that the work should now proceed on a more practical basis, rather than to wait for further development in fatigue-measuring devices.

As opposed to the purely scientific research being carried on by Dr. Moss, Dr. Brandenburg's paper approached the problem from a psychological point of view. Following Dr. Brandenburg's preliminary investigation, he developed a questionnaire in a form on which individuals were enabled to check their answers on a scale on which three points, both ends, and the center were indicated as the relative qualitative answers and the mean which might be expected. This information was then worked into a graphical form, using the usual statistical evaluation method, showing the arithmetic mean, standard deviation and probable error. The first results of the investigation by Drs. Brandenburg and Swope, covering ratings of 125 people, were presented in the forms of such charts both for the totals and also after separation into sexes.

From these charts the authors draw a number of tentative conclusions, tentative due to basing the charts on only 125 people. Wealth distribution, as indicated by types of cars owned, however, was rather good; 37 Fords and Chevrolets, ten Dodges, 20 Buicks, two LaSalles, a Cadillac, and a Stutz, etc. Ages of men ranged from 18 to 51, with an arithmetic mean of 27. The ages of the women ranged from 17 to 27 as near as could be told, with a mean of 20 years.

Following are some of the conclusions:

Vertical motion, swaying motion and skidding are undesirable; vertical motion most of all, and swaying more to women than to men. (See Fig. 2a.)

Noises from various sources are very annoying, with body squeaks most important. Unidentified noises worry men more than women. (Fig. 13a.)

As opposed to the purely scientific research being desirable. (Fig. 14a.)

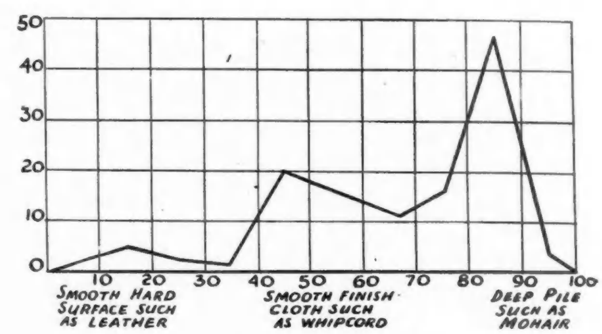


Fig. 18—Kind of Upholstery

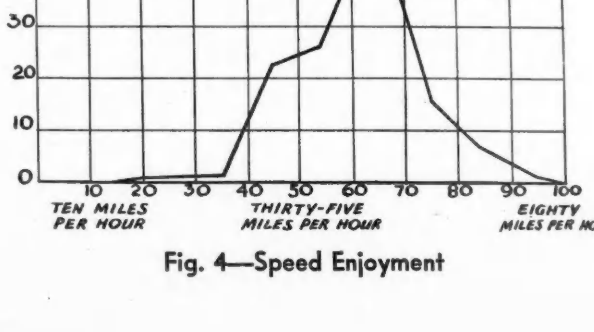


Fig. 4—Speed Enjoyment

There are significant *sex differences* with regard to the following also; *skidding* (Fig. 3a); *acceleration,* (Fig. 5a); *retardation* (Fig. 6a); *depth of seat* from front to back (Fig. 21a).

The comfortable *qualities in riding* are often mental. Fatigue may be due to these mental qualities as well as bodily discomfort.

In his analysis of wind resistance, Mr. Pawlowski gave a brief outline first, of aerodynamic fundamentals, leading up to the enumeration of the three subdivisions of wind resistance; eddy-making, skin-frictional and induced drag. Of the various methods of studying wind resistance, the author favored the method of aerodynamic reflection, using two identical but reversed models to obviate the ground effect in wind-tunnel testing. In this respect Mr. Pawlowski did not obtain entire agreement from his audience, the discussion bringing out an objection that the reflection method does not take into account the "dragging" of air along the road by the car traveling over it.

In studying, by this method, Capt. H. O. D. Segrave's Golden Arrow, reproduced in model form, the author arrived at the conclusion that the ground effect of the car, due to the low leading and trailing edges, increased the total drag by about 100 per cent at 90 m.p.h., pointing out that a higher position of the leading edge would have made for higher speed. In this respect the discussion, however, brought out that the reduction in the negative lift obtained by raising the leading and trailing edges was undesirable from a safety point of view, as it might become impossible to keep the car on the ground.

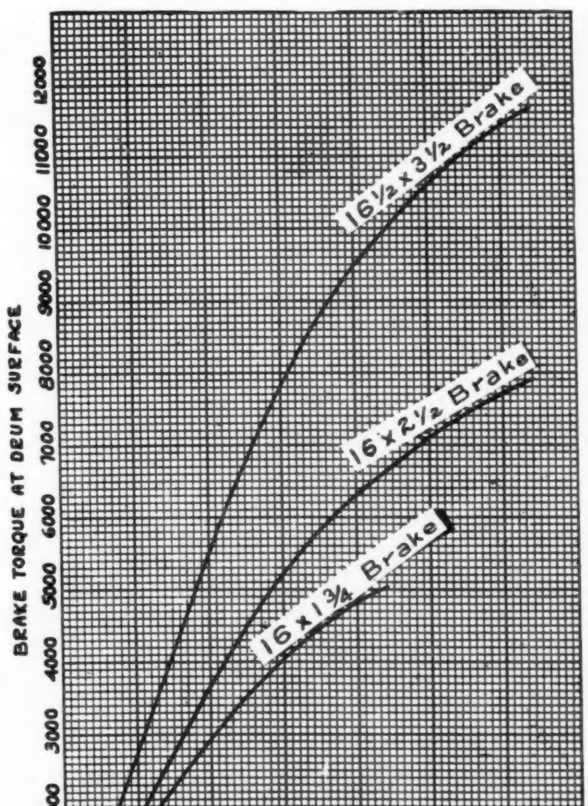
Design and Operation of Brakes

WHILE rather general titles were assigned the two papers presented at the Brake Session, Tuesday, May 27, at the Summer Session of the Society of Automotive Engineers in French Lick Springs, Ind., both dealt with a specific type of brake. The first paper, entitled "Fundamentals of Brake Design," by A. W. Frehse, engineer, Chevrolet Motor Co., Detroit, in effect formed a description of and the reasons for the type of design developed by the General Motors Research Laboratories, and generally known as the Houck type brake. The second paper, "Electrically Operated Vehicle Brakes" by John Whyte, chief engineer, Warner Electric Brake Co., also led, after discussion of the reasons for non-mechanically energized brakes, to a description of the brake produced by Mr. Whyte's company, and which had been described previously in *Automotive Industries.*

The reasons given by Mr. Frehse for selecting a shoe-arc of only 120 deg. was that this length was sufficient for any design of shoe brake. "Some engineers are of the opinion," Mr. Frehse said, "that the longer the lining of a shoe is, the longer the life will be. This would be true if the normal pressure against the lining were equal at all points. But it does not apply in the case where the initial pressure is applied at the free end of the shoe. Many attempts have been made to secure equal normal pressures all around, but so far they have proved to be unsuccessful."

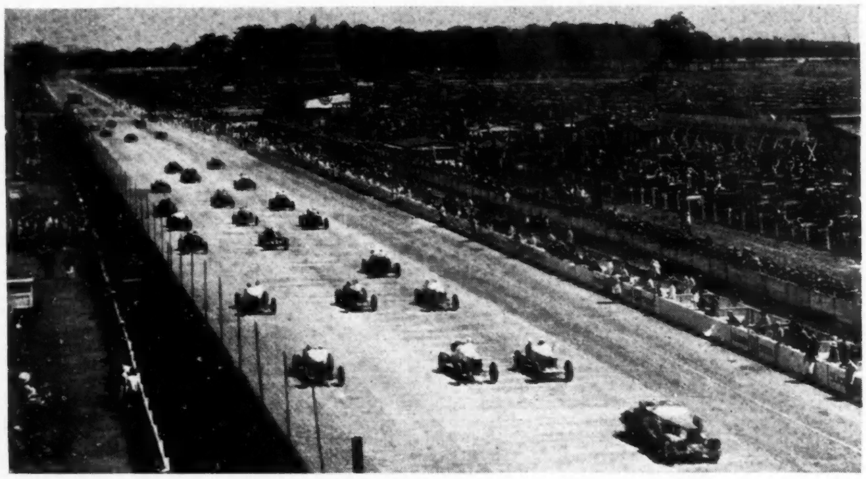
Other arguments used by the author for the shorter shoe include the decreased cam and therefore pedal travel; loss of pedal travel due to heat expansion, drum distortion; give in the hook-up mechanism; fade-out or shoe curl. These were pointed out by the author as already serious enough to warrant all the pedal travel conservation possible. Another interesting statement made by Mr. Frehse was that he firmly believed that the time is not far off when linings can be specified with the certainty and confidence that apply to modern alloy-steels today.

Mr. Whyte's paper in addition to a discussion of electric-operated brakes also emphasized a number of general points in car design which apply to practically any type of brake. Of these one of the most important referred to the necessity of increasing the ability of the front end of vehicle to resist increased brake torsional forces. These means, according to Mr. Whyte, should especially include precaution against the reversal of castor, it being the author's contention that front end instability, etc., was far more responsible for the apparent tendency of a vehicle to steer off to one side with a brake application than poor equalization of brakes themselves. In this connection, Mr. Whyte believes that such changes in design should contemplate the absorption of braking forces independent of spring suspension.



The current consumption of the Warner Electric brake, for three sizes of drums, plotted against desired brake torque

Speed With Reliability Shown at



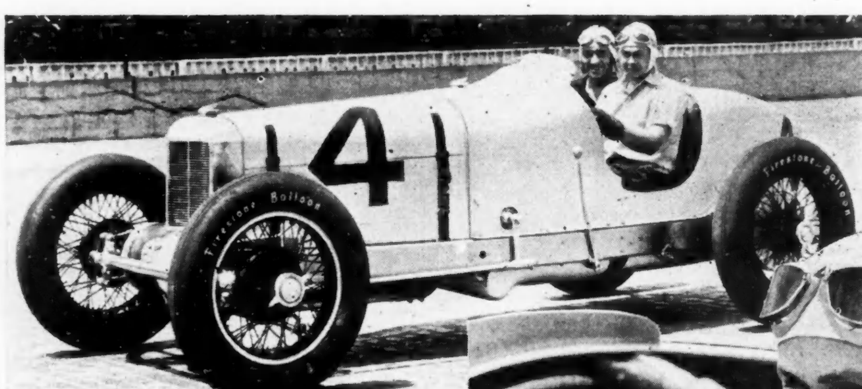
Thirty-eight cars started at the Speedway in Indianapolis for the annual 500-mile classic

Race cars under the 1930 rules show superiority in the 500-mile grind over the 91-in. supercharged jobs

By Paul Dumas

THE winning of the 1930 Indianapolis 500-mile race by Billy Arnold, besides being a tribute to his skill and the mechanical preparation ability of Jean Marsenac and the owner Harry Hartz, also divulges to the student of racing certain interesting observations. The first of these is that the 1930 model, non-supercharged, two-man race car can traverse the 500-mile distance on the Indianapolis type track at a higher average speed than either the 91 or the 122 cubic inch, one man, supercharged type. This despite the fact that the track record of 101 m.p.h. was established with a 122 cubic inch supercharged one-man Duesenberg, driven by Peter De Paolo.

De Paolo's average was slightly less than a mile per hour faster than the 100.448 figure turned in by Arnold but, had not the 1930 field been flagged to caution speed, for about five minutes, due to a six-car pile-up, the average would easily have risen to 102 m.p.h. Furthermore, the winner was never seriously challenged and at all times after the 250-mile mark, except during his one pit stop, maintained a lead of four laps on the runner-up. Possessing such a lead, the driver wisely chose to play safe and ran most of the distance at well below his maximum safe driving speed. Correction of the average by calculating the effect of the two



Billy Arnold, with Spider Matlock (right), drove the Hartz eight-cylinder special to victory at Indianapolis at an average of 100.448 m.p.h. for the distance, close to the track record

Indianapolis

factors just mentioned establishes the fact that the 1930 jobs are faster at the 500-mile distance, but it does not tell the whole story, because the supercharged one-man jobs are admittedly faster as to top speed. It is the old story of the sprinter who failed to make his mark in the marathon.

The 1930 model race cars are not as fast at the short and sprint distances as the supercharged 91 or 122, but they surpass the latter in the 500-mile grind. Of the several reasons for their higher average over the long distance, probably the most important is reliability as expressed in fewer pit stops. Pit stop records covering the one-man supercharged type cars were not at hand at the time of writing. It is interesting to note, however, that this year there were only seven pit stops due to spark plug trouble and that these were confined to six cars. Furthermore, none of the ten place winners changed any spark plugs. Of the theories advanced for this good showing, the majority credit it to the absence of the supercharger, although this is open to discussion.

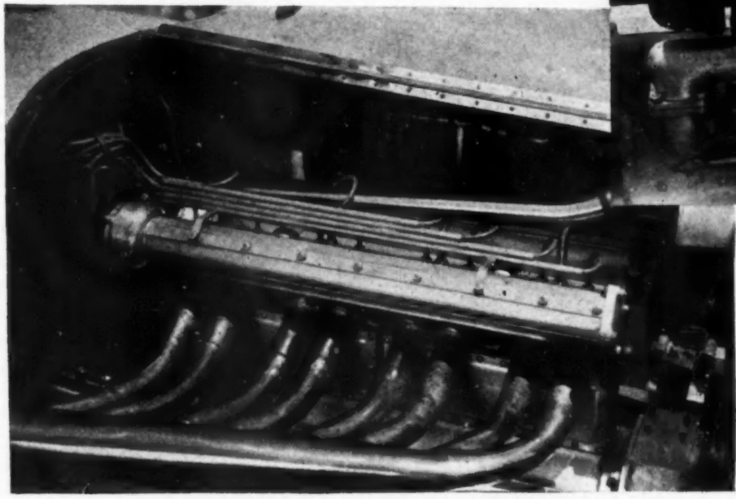
Many of the drivers and officials believe that one of the important factors enabling the high average was a considerable reduction in the amount of oil on the track surface. This is due to the fact that the 1930 cars leak less oil, which means better traction and a safer track for any given speed. The centrifugal-type supercharger is blamed by many as being the worst offender in the matter of oil leakage, due mainly to the methods used for lubrication. At any rate, the 1930 cars which were not equipped with superchargers are credited for the improvement. One driver who covered the course in a passenger car shortly after the event stated that there was only about one-fourth as much oil on the track as last year.

Although the top speed of this year's cars was less than shown in recent Indianapolis races, the differential is small enough to indicate that they are within striking distance of former standards. The record qualifying speed is 122-plus m.p.h. made with a one-man supercharged Miller-built 91½-inch-engined car driven by Leon Duray. The fastest qualification this year was 113-plus m.p.h. Incidentally, it is the same qualification speed attained by Peter De Paolo the year he set the 500-mile record for the track at 101.13 m.p.h.

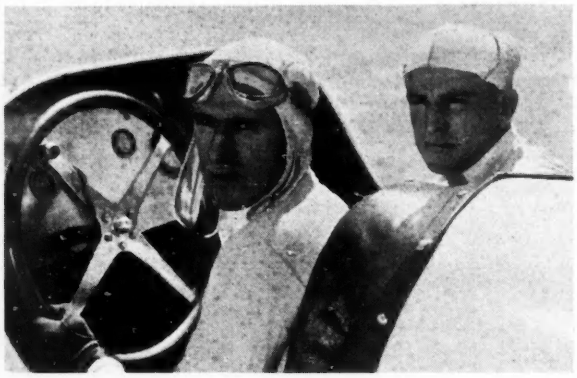
In their efforts to get power output, builders of this year's race cars naturally turned to increased piston displacement to offset the removal of the supercharger. It is interesting to note, however, that the engine of the winning car was of 150 cu. in. displacement, that the engines of the first four cars were of less than 200 cu. in. displacement, and that only two of the thirteen cars that finished or were running at the finish had in excess of 251 cu. in. displacement.

Among the items contributory to the high power output of the 1930 Indianapolis rules engines is extremely high compression. Never before were the ratios as high as utilized this year. One of the 91½ cu. in. Miller eights carried a fourteen-to-one ratio. All but two of the Miller fours of 3¾-in. bore used a 9.7-to-one ratio, and with a few exceptions notably among the larger eight cylinder engines the commonly used ratio was of the order of ten to one. All contestants with one exception used tetraethyl lead doped fuel in amounts as high as 13 cc. per gallon. It should be said to the credit of the supercharger that it probably was instrumental in providing the problem that caused plug makers to produce a spark plug that easily met the requirements of the non-supercharged high compression engines.

The generally higher rotative speeds of the supercharger equipped 91½ cu. in. engine was also productive of valves and valve springs of improved design. The introduction of these in the 1930 engines of slightly slower speed gave them a safety factor that contributes much to the reliability of the pres-



Much of the credit for winning the Indianapolis race is given Harry Hartz and Jean Marsenac in preparing the winning engine, two views of which are shown



The runner-up, Wm. "Shorty" Cantlon, in the four-cylinder Miller Schofield. Ernie Olsen was the mechanic who prepared the car

ent cars. Three springs per valve were utilized in the Miller engine of the winning car. From the standpoint of plugs, valves, pistons and valve springs, the 91½ cu. in. supercharged engine should be credited with producing a better 1930 rules engine.

The 1930 rules placed the limit on number of carburetors at two, and classed a duplex type as two carburetors. Such restrictions automatically brought about hurried research and experiment and although most of the contestants used the downdraft type of manifold, the detailed designs were many and varied. With a few exceptions, the carburetors were installed as two single units of downdraft type and Winfield manufacture.

Soon after the new rules were announced last year, it was predicted that the cars starting in the 1930 race would be of widely varying design. To some extent the prediction has been fulfilled, because, among the starters were two sixteen-cylinder cars, twenty-four eight-cylinder models, two cars with six-cylinder engines, and ten with four-cylinder engines.

The last named are interesting from many angles. In the first place, it indicates a decided race revival of the four-cylinder type powerplant which has not been seen at Indianapolis as a real contender since the days of the famous Peugeots and Chevrolet-Frontenacs. Secondly, they performed in a creditable manner and give strength to the saying that in building engines it is not entirely what you do, but the way you do it, that counts. To take a quick glance at the record of the fours this year, we find that of the ten starting, one finished second, one finished seventh and one finished ninth. The four that finished second showed the third fastest qualifying speed.

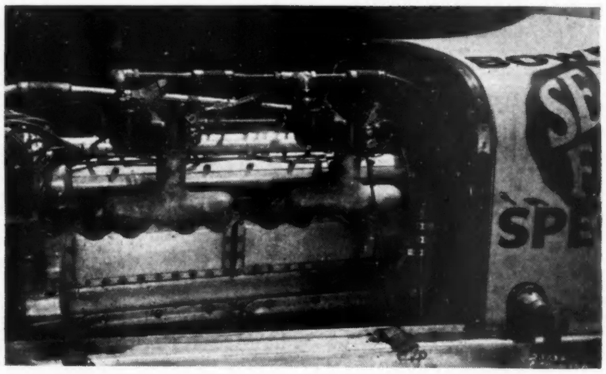
One four-cylinder job, a rebuilt Ford, was running at the finish and would have finished well up in the money except for a forty-two minute pit stop to renew the front chassis spring. Incidentally, the spring replaced was "borrowed" from a spectator's model "A" Ford standing just outside the fence.

Two of the six remaining four-cylinder cars were eliminated due to broken valves, the third to a broken piston, the fourth to a broken wrist pin, the fifth to a broken connecting rod and the sixth and last was wrecked against the outer wall.

Four-cylinder engines were used for power in the Mavv, Coleman, Guiberson, Miller Schofield Special, Miller Allen Special and Empire State Special. These engines are of 3¾ in. bore by 4⅛ in. stroke and peak at slightly above 5000 r.p.m. When their operating piston speed of 3300 feet per min. is considered, the number of failures does not seem high. They have been used to some extent as a marine powerplant and it is believed by those drivers now using them that another year of development in automobile racing will show a substantial improvement in their reliability.

Little need be said about the winner's car except that for the cylinder blocks the engine is a stock 122 in. non-supercharged two-valve-per-cylinder Miller engine. New cylinder block patterns were made and cylinders cast to bring the bore up to 2⅝ in. The stroke of 3½ in. is the same as the 122 engine. The increase in bore brought the displacement up to 150 cu. in. approximately. The chassis in which the engine was installed was a new standard Miller front drive model designed to carry the supercharged 91½-in. Miller engine. Extreme care and skill in the assembly of the job plus the utilization of a few small improvements originated by Hartz accounted for the excellent performance of the car. Drivers of the competing cars admitted freely that this front drive car negotiated the turns at decidedly higher speed than was possible with the rear drive type. This advantage of the front drive is more marked on a track like the Indianapolis 2½-mile speedway, whereas on the dirt and board tracks many drivers state the rear drives seem to corner as well or slightly better. Incidentally Arnold's victory is the first Indianapolis win for a front drive car.

The semi-stock cars, generally speaking, gave a good account of themselves. Both of Peter De Paolo's entries were shortened editions of the 1920 to 1928 stock Model A Duesenberg eight with race car rear axles. The biggest deviation from stock was the use of a newer type cylinder head and two down-draft carburetors. These two cars were the fastest of the semi-stock group. The one driven by Cummings finished fifth.



Miller engine, 122 in. model, in Louis Schneider's third place car, the Bowes Seal Fast Special. Note the manifolding

Next fastest semi-stock car was the Snowberger revised Studebaker President eight, which differed from the strictly stock chassis in the use of ball bearing equipped front and rear axles, ball bearing mounted accessory shafts, downdraft carburetion and magneto ignition. This car was by far the fastest "L" head engined job in the race and finished in eighth position.

Except for oil and gasoline tanks of special con-

(Continued on page 885)

Engine Acceleration Research Concluded by Cooperative Body

The President's Tribute

"Please extend my cordial greetings to the convention of the Society of Automotive Engineers and my congratulations upon the 25th anniversary of the founding of the Society. The technical progress of the art which they profess is one of the marvels of modern times and has contributed incalculably to the liberation of mankind from the limitations of time and space."

—Herbert Hoover

One phase of the general study of the economic volatility of fuels, begun in 1920, is reported to S. A. E.

THREE papers were presented at the Research Session of the S.A.E. Summer Meeting at French Lick, held on Thursday morning, May 29, with B. B. Bachman, vice-president of Autocar, occupying the chair. One of these papers was on Engine Acceleration, by Clarence S. Bruce, assistant engineer of the Bureau of Standards. The research work on engine acceleration is one phase of the general study of the economic volatility of fuels which was started as far back as 1920 by the S.A.E. Committee on the Utilization of Present Fuels in Present Engines and was later continued under the direction of the Steering Committee of the Cooperative Fuel Research. This phase of the general problem (engine acceleration) has now been concluded and the following resumé of the results obtained was given by Mr. Bruce:

1. Road acceleration tests have been demonstrated to yield information neither sufficiently precise nor sufficiently detailed to permit determining definitely the causes of readily detectable differences in acceleration performance.
2. A portable spark accelerometer has been developed, with which engine acceleration can be measured as precisely as variations in other engine factors warrant. This instrument is simple in operation and moderate in cost.
3. Technique of operation and methods of analysis have been developed, enabling a maximum of results to be obtained from each test.
4. The effect of fuel volatility is shown to be qualitatively independent of engine design.

Three Acceleration Factors

5. The effects on acceleration of increasing (a) the heat applied to the manifold, (b) the fuel volatility, (c) the accelerating charge, are similar, all three acting to increase the acceleration at low engine speeds. However, if the supplied mixture is as rich as that which gives maximum power, heating the manifold or increasing the volatility of the fuel will increase the acceleration at low speeds but will decrease it at higher speeds.
6. Proper proportioning of the quantity and rate of injection of the accelerating charge, together with use of the carburetor setting giving maximum power at constant speed operation, makes it possible to realize practically the computed maximum acceleration over the entire speed range.
7. The total induction system surface to be wetted is a determining factor in fixing the amount of accelerating charge required to produce optimum acceleration performance, and therefore, when no accelerating charge is used, in limiting the acceleration performance.

W. C. Bauer, of the research laboratory of the Standard Oil Development Co., Elizabeth, N. J., presented a paper on the Vapor-Locking Tendencies of Automotive Fuel Systems. He stated that internal combustion engines can be installed in vehicles of all types so that vapor lock never occurs under any conditions of service. However, in practice gas lock does occur under warm weather operating conditions, from which the conclusion may be drawn that it is more dependent upon design than upon the fuel.

Vapor Lock and Stalling

Gas lock is due to too high temperature of the fuel supply and manifests itself in four different ways. The most common complaint is failure of the engine to idle after a fast, hot run or in traffic. Next in order of occurrence is intermittent or uneven running during acceleration after a period of idling. Intermittent operation or "locking" during a sustained high-speed run is also a form of this trouble. A rare but extremely annoying phase of vapor lock is a complete stopping of the engine.

Stalling may be due to either a too lean or a too rich mixture for operation, depending on the type of the carburetor. With a carburetor of the plain-tube design having a separate idling tube and a jet feeding in above the throttle valve, the trouble is invariably a too lean mixture. Vapor bubbles form faster and faster in the idling riser as more and more heat flows back into the carburetor, until nothing but vapor is delivered to the idling jet and the engine stops.

In the case of an air-valve carburetor just the opposite occurs. The vapor bubbles, rising through a tube, the outlet of which is but slightly above the fuel level, act as gas lifts, pumping fuel out of the jet until a too rich mixture is supplied and the engine stalls.

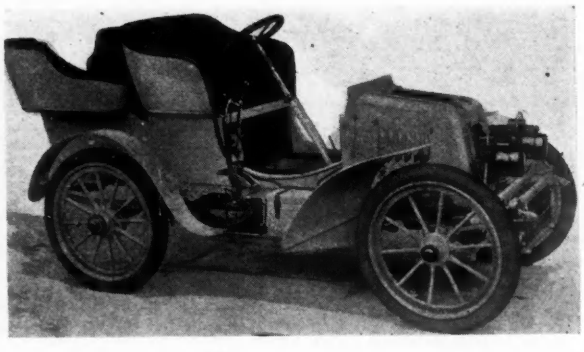
Uneven operation during acceleration usually marks the passage of vapor bubbles through the main jet, the cutting off of liquid flow being responsible for one or more of the cylinders receiving mixtures too lean to be fired. With some plain-tube carburetors that function

(Continued on page 880)

Do You

Pageant at French Lick of Automotive Engineers buggies, flap-seat tonneaus

By A. Ludlow



This old Paige-Detroit (above), and a Peerless of the vintage shown (right), were present at the roll-call of old-timers

ACTION speaks louder than words, so the real big thrill I got from the old cars at French Lick was the sight of Art Scaife cavorting about the grounds in the White Steamer. What strange memories that stirred.

About 1904 I had a job with the Warminster Motor Co. in a little country town in England, and among other early cars we sold several Whites. They all gave good service, but what a time we had teaching coachmen to drive them! I well remember a case where the owner and his man had pushed the car out of its garage and closed the doors. Then they got up steam and the owner got in and opened the throttle. Nothing happened so he opened it some more. The groom then remembered that to start from a standstill a pedal had to be depressed letting extra steam into the cylinder and this really should have been done before touching the hand throttle. He said to the owner, "You haven't pressed the pedal, sir," so the former with the throttle now wide opened tramped on it.

The car took one leap clean through the garage doors, swept away the far end of the shed and carried the whole structure twenty feet or so before fetching up in a bank. The point of this tale is that despite all the wreckage the car was hardly damaged. A complete new garage had to be built, but less than fifty dollars fixed up the car. They were good cars and my early White experiences still make me wonder sometimes whether steam may not yet come back on the roads.

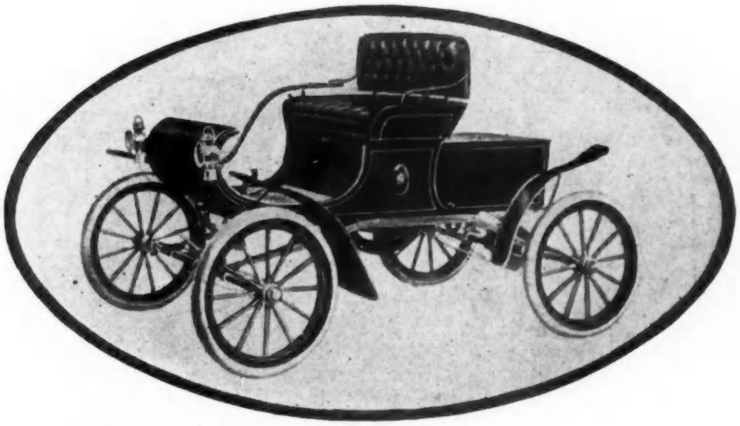
The gasoline cars in the pageant at French Lick were fascinating to me first for the memories they raised. The Paris-Bordeaux race winner of 1901, being a foreigner, really did not belong in an American exhibit, but it took me back to my last year in high school. A time when I had made up my mind that I would follow automobiles but my elders had me destined for railroading.

Looking at that little Renault it seems incredible that it was really that small; in those days it loomed as a monster of speed and power. But a second reaction from the exhibit, something I had not expected, was a realization that after all these pioneer mechanisms comprise almost everything we have today. Barring the self-starter there isn't one feature of the modern automobile that is wholly new. Back in 1905 they had it all and ever since we have done nothing but refine.

As a memory stirrer another outstanding exhibit was the Oldsmobile. How many thousands of miles I rode in one of those I can't remember, but every mile was a delight. One early model had a chain designed to come apart easily for the insertion of new links. When folded back the links could be unhooked. It was a grand idea but did have its drawback. I remember spending an afternoon on my back under one of these trying to feed a new chain around the differential. It goes in at a slot in the top of the housing and comes out at another slot near the bottom. I found the detachable links had a trick of detaching themselves during this threading operation, and every time a link was lost it meant a fishing expedition with a wire and then try again. But the one-lunger Olds was a real car in days when real cars were rare.

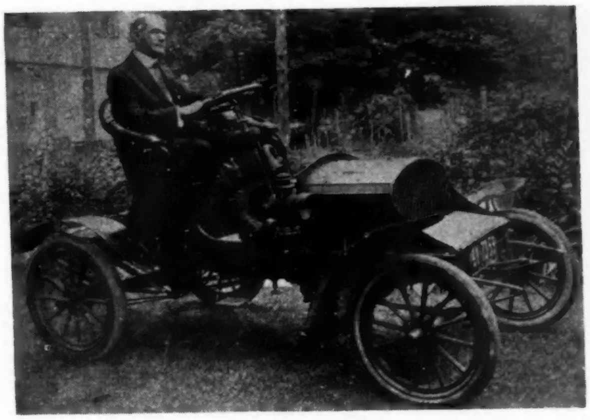
It reminded me of a notable absentee from French Lick—the Duryeas. I once drove the original three-wheel racer of this make and several of the subsequent models. I can't say they were trouble free, but when they did go how they went! Our ambition was always

Remember?



meeting of the Society recalls the days of gasoline- and side baskets + + +

Clayden



A Reo curved dash car (above), and a Franklin, similar to the one shown here, brought back memories of the early days of the S.A.E.

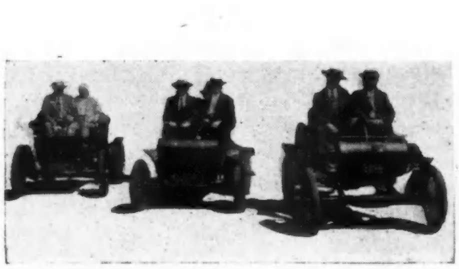
to do Coventry to London—90 miles—in four hours. I have done portions of that ride in much faster time, but I cannot remember ever completing the journey in one day though it must have been done.

Ignition was our main trouble in those days on all cars and up to as late as 1906, when driving a Panhard, I usually cut out the electricity and ran on the hot tubes. Cranking up on the tube ignition was a knack which I early acquired and I never remember it failing to function.

Speaking of Duryeas, we have pretty well forgotten what a hard fight the buggy-type car made. There was the true buggy design like the Holemen car at French Lick, rope driven to both back wheels from a horizontal engine under the floor which Duryea tried after his earlier machines; and the modified buggy type probably originated by Benz in Germany and more or less reproduced in general scheme by Oldsmobile, Ford and a host of others. In my opinion these machines actually looked better than most of the early bonnet types.

The Oldsmobile in the exhibit had graceful lines; the early Peerless, which was of the 1902 European model with a flap seat tonneau and side baskets, looks like a Goldberg drawing by comparison. Lines on the bonnet type came earliest with the speedsters, as instance the 'round-the-world Hupp, which had real appearance of speed, partly due to the high radiator cap and the raked steering column.

It might be hard to trace, but probably the strictly engineering fraternity have little to put to their credit on looks. Cars with good body lines probably came only after carriage designers had experimented and realized the artistic possibilities. There is, too, one very important difference between European and American development that I think I never before realized—although I knew it. This is that the foreign development was all along luxury lines while from the very start we had the utility idea. The Oldsmobile, the early Fords and all the semi-buggy types had utility in the forefront. These were wholly American; they took nothing from Europe except a few basic principles of mechanical arrangement. From these grew the low-priced car and low-cost methods, as instance the first Dodge body; not so beautiful, by today's standards, but strong and fit for any amount of severe work.



Those were the adventurous days but not altogether the happy ones. For while that exhibit brings to mind many joyous memories it brings many more of nights spent in trying to coax a spark from a dead dry battery; of pushing behind while the other fellow tried to drive up heavy grades; of ruined clothes, and most of all of punctures and blowouts—17 self-made repairs in one day is my record and I'll never forget that day—for, of course, it rained, too. Yes, adventurous—and laborious.

But after all, it is the accessory men who have given us reliability. Ignition, tires, lamps, radiators, those were the things that went out on us most often. Our engineering was sound enough in fundamentals, pistons and cylinders, crankshafts and gears, even chains and steering were fairly reliable. But let us give the due credit to Robert Bosch, to Atwater Kent, to Kettering, to the rubber chemists whose names are lost to history; they deserve places in the halls of fame at least equal to those of R. E. Olds, Henry Ford and Charles E. Duryea.

Just Among Ourselves at

By Norman

Coker F. Clarkson

ACUTELY as the Society of Automotive Engineers must feel the loss of Coker F. Clarkson, it is difficult to think about him in any formal terms at the moment.

Individually and as a Society, we have lost one of the finest and fullest characters ever connected with automotive affairs.

Broad in his sympathies as in his vision, high in his ideals as in his attainments, Coker Clarkson leaves to his friends, his profession and his industry a heritage of vital inspirational memories.

The Silver Anniversary Fittingly Celebrated

THE twenty-fifth anniversary festivities of the Society of Automotive Engineers, celebrated in the twenty-sixth year after its founding, have passed into history.

It wasn't the largest summer meeting the Society ever had, but it was one of the best. Every phase of the meeting which had to do with the Silver Anniversary observance came off admirably. Well organized, well operated and interestingly performed, the whole anniversary celebration gave a thrill of interest to the younger generation as well as pleasure to the oldtimers who were there. Our hat is off to Fay Leon Faurote, to whom must go much of the credit for the handling of this phase of the French Lick meeting.

On other pages of this issue Ludlow Clayden writes of the anniversary celebration and exhibits in such interesting style that we are loath to talk more of it here.

\+ \+ \+

Col. Alden Visions The Society's Future

PLENTY of good, live ideas were expressed at the various sessions by the currently active engineers who read papers and took part in discussion.

But it remained for H. W. Alden, a member of the society since 1905 and twice president of the organization, to propound the most vital, forward-looking thought of the meeting. Not content to reminisce about past achievements of the society, Mr. Alden visioned a vigorous future program, designed to meet new conditions and to achieve new services for the industry in the interesting years that lie ahead.

Specifically he suggested that the society may be of assistance in giving technical advice to legislators, while automotive measure still are in the process of legislative discussion. But his general suggestion we interpret as being broader than that.

\+ \+ \+

Broad Platform Given For Structure of Service

HOW many of those who sat in that session and listened to Col. Alden's words felt that they were listening to a pronouncement of epochal importance to the society, we do not know. It is our personal belief that his statements are likely to give impetus to an entirely new conception of the possible scope and function of the Society of Automotive Engineers, and that those of us who heard him were sitting in at the what may well turn out to have been the starting point of a new era of intensified and applied service on the part of this great engineering organization.

Psychological Research Applied to Riding Comfort

ENGINEERS may be nearer than ever before to quantitative measures of riding comfort as the result of papers and discussion at the body session, where there were presented quantitative data resulting from research into the psychological as well as the physical elements involved in this perennial problem.

The studies from a physical standpoint, long under way, were further amplified by Dr. Moss. Professors G. C. Brandenburg and Ammon Swope of Purdue University developed the psychological aspects of the problem in statistical form. Details are presented on other pages of this issue. We commend them to the attention of every engineer.

We hold no brief for the conclusions drawn by these latter professors as a result of their researches. They based their study on only 125 people, many of whom were of a single type—college students. The importance of their research, as we see it, lies in the research method which they have developed. It is quite conceivable that the industry would get its money back manyfold if application of their method could be made to some 10,000 or more properly selected persons.

\+ \+ \+

Non-Stock Special Cars Were There in Numbers

AS usual, plenty of non-stock vehicles of one kind and another were brought to the meeting this year. William J. Mueller, Moon's new president, was there with a Ruxton equipped with a supercharger and some other special devices. C. L. Cummins' Diesel-engined car

French Lick Springs

G. Shidle

didn't participate in the Indianapolis Race after all, but he brought to the meeting the Diesel-engined Packard car with which he made such good records at Daytona recently. Then there was a "Noiseless Cord," driven to the gathering by William Barnes, Auburn's experimental engineer; and a Chevrolet job equipped with a special springing consisting of a bell crank lever working against a helical spring—not to mention a Mercedes Diesel-electric bus. Probably there were other interesting "specials" there, but that's all that we got around to.

\+ + +

Silencing and Lubrication Major Developments Pending

ONE inquisitive engineer, after circulating widely among his fellows at the meeting, came to us with the statement that two of the most important pending design developments in the industry are:

1. Complete silencing of the engine, including carburetor and fan, and—
2. Completely automatic lubrication of all chassis bearings.

\+ + +

Multi-Cylinder Models Sure for High-Priced Lines

LAST winter we came away from the New York Show pretty well convinced that at least five or six new twelve or sixteen-cylinder passenger cars would be on the market before the end of January, 1930. Having checked up around this S.A.E. meeting we see no reason to discard that belief, although it does look as though the time of actual announcement is likely to be delayed somewhat.

Engineers connected with all of the higher priced passenger car companies, however, seem to be generally well informed about problems and possibilities in connection with these so-called multi-cylinder jobs. We found one competent technical observer, not in the passenger car field, who believes that every high-priced car eventually will come to building at least one model with twelve or more cylinders.

\+ + +

Spirit of the High Hats Survives in Foreign Land

THE Detroit "High Hats," S.A.E. musical perennials, were in evidence as usual, but some old faces were missing. The latter seem to have been there in spirit, however, as evidenced by a cablegram from Germany signed by such famed musicians as Eddie Rippingille, Fred Cornell, Charley Crawford and several others. The cable sent greetings to those at the meeting, adding, "Wish you were here and we were in French Lick."

\+ + +

Supercharger Appears To Grow in Favor

DESPITE—or because of—elimination of superchargers from Indianapolis Race cars this year, a number of engineers could be found who still are interested in discussing the pros and cons of this particular unit. One enthusiast sees its wider use as certain, and believes widespread application to automotive units will come in the following order: Airplanes, motor boats, buses, trucks, passenger cars. Plenty of other engineers agree as regards airplanes.

Past Presidents Attend In Goodly Numbers

WITH a large group of old timers at the meeting, there seemed to be an unusually large number of "middle" timers ou the absence list.

Past presidents made a good showing, those in attendance being Andrew L. Riker (1905-1907); Herbert W. Alden (1912 and 1923); C. F. Kettering (1918); J. G. Vincent (1920); David Beecroft (1921); B. B. Bachman (1922); T. J. Litle, Jr. (1926); W. G. Wall (1928); W. R. Strickland (1929). Henry M. Crane (1924) was prevented from attending at the last moment by an attack of pleurisy.

And to this list of distinguished attenders should be added E. P. Warner, 1930 president, and Vincent Bendix, who will steer the affairs of the society in 1931.

\+ + +

There Were Some Records Made—But Not by Us

CANNON BALL BAKER blew into the meeting on one of the early days, after having driven from Indianapolis — 110 miles—in something like 99 minutes. Then Tommy Milton arrived on Thursday, having covered the same route, according to the Daily S.A.E., in 92½ minutes.

We rode back from French Lick to Indianapolis with H. L. Ames, Detroit representative of Whitney Mfg. Co., and had a mighty pleasant trip, failing to equal Milton's record by about 90 or 100 minutes (which was OK with us).

\+ + +

An Automobile Was Undefined—Then

Edward T. Birdsall, who took the initiative in the organization of the S.A.E., said that when the Society was founded, the founders were unable to find in the dictionary any definition for the word "automobile."

Talking It Over

Miller McClintock, vice-president, National Safety Council and Director of the Albert Russell Erskine Bureau for Street Traffic Research, Harvard University; J. Allen Davis, associate counsel, Automobile Club of Southern California, and legislative draftsman for the National Conference on Street and Highway Safety, and Col. A. B. Barber, manager of the Transportation and Communication Department, Chamber of Commerce of the U. S. A., and director of the National Conference on Street and Highway Safety, photographed in the courtyard of the building of the Chamber of Commerce of the United States. The sessions of the National Conference on Street and Highway Safety were held in main assembly room of the building by courtesy of the Chamber

Because defective vehicles contribute to the nation's accident total the Street and Highway Conference recommends

Junking Plans

TAKING into consideration the conclusion that vehicular defects are an important or contributing factor in 15 per cent of motor vehicle accidents, the Committee on Maintenance of the Motor Vehicle strongly recommended the junking plan now in use by a number of automobile factories as a step in the direction of eliminating unsafe vehicles from the highways of the nation. The report was presented at the Third National Conference on Street and Highway Safety, held in Washington, D. C., May 27, 28, 29.

In discussing provisions for maintenance of vehicles operated by private owners, the committee reported that "One step in the right direction is the setting up and advertising by dealers of standard servicing plans whereby either a general inspection and minor adjustments are made monthly at a flat rate, or inspections of more elaborate scope, at a fixed price, are recommended to the customer at certain intervals."

The report embodying these conclusions was one of a series on problems of street and highway safety presented at the conference. Other special reports considered education of the motorist, enforcement of traffic and other laws relating to the registration and operation of motor vehicles, the relief of traffic congestion, protection of grade crossings and highway intersections, and uniform traffic regulation.

Broadly speaking, the work of the third National Conference on Street and Highway Safety included two divisions, one devoted to preparation of special reports and recommendations respecting the subjects outlined above, and the second, concerned with formulating the recommendations of the committees into a system of uniform laws to be used as a base for state and municipal legislation for the regulation of vehicles.

At previous conferences in 1924 and 1926 the general basis of such recommendations and legislation was laid down, and since that time conclusions of the conference have been the basis for all or part of the motor vehicles codes in twenty-four states and several hundred municipalities.

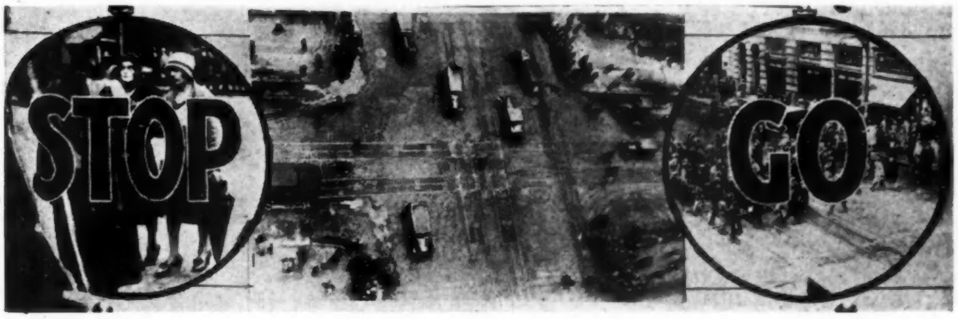
Work of this year's conference therefore, necessarily, consisted chiefly in refining the codes and recommendations, bringing them up to date in respect to developments subsequent to former conferences, and giving new impetus to the consideration of methods of obtaining greater safety on the highways.

Practical interest was given the present conference by the fact that forty-four state legislatures will meet in the autumn of this year, and it is hoped that the conclusions of the present conference will be included in the vehicle-regulation codes of additional states, with a consequent reduction in accidents and loss of life from automobile accidents on the highways.

Two classes of legislative codes were formulated by the previous conferences. One, the Uniform Vehicle Code, divided as follows, Act I, Uniform Motor Vehicle Registration Act; Act II, Uniform Motor Vehicle Anti-Theft Act; Act III, Uniform Motor Vehicle Operators and Chauffeurs License Act, and Act IV, Uniform Act Regulating Traffic on Highways.

The other division of the legislative work was the "Model Municipal Traffic Ordinance" designed for use in municipalities in states where the "Uniform Act Regulating Traffic on Highways" had not been adopted, or for use in conformity with the latter, when it had been passed as an enabling act by the state legislature.

Section by section consideration of these legislative codes as previously formulated, in the light of the new



By Herbert Hosking

as Major Safety Factors

reports by committees, which had done the bulk of their work previous to the actual conference, took up much of the working time of the sessions.

The appointment of a drafting committee to express the sentiment of the conference in language which would pass the test of legislative scrutiny was an early consideration. This drafting committee served also as a resolutions committee, and as a steering committee for all measures considered on the floor of the conference.

Early in the conference it was apparent that a fight would center around the efforts of the National Automobile Chamber of Commerce and other interests to eliminate Section 20, subsection (b) of the Uniform Motor Vehicle Registration Act, which limits licensing reciprocity between the states to thirty days in the case of buses and common carriers of freight. Elimination of this section meant that the development of bus lines and motor freight lines in the United States would have one of the chief restrictions to healthy and economical development—duplicate taxation—removed. The Drafting Committee of the conference, at its first session, voted the removal of the restraining section, and no further objection to its removal was offered by the conference.

Maintenance—street and vehicular—is a national problem .... Safety Conference report

The important question of limitation upon the speed of vehicles on the highways came up with the report of the committee which formulated the Uniform Act Regulating Traffic on Highways. The conference developed considerable sentiment indicating that the recommendations of the committee were too complicated to meet the mental status of the average driver. They had been prepared originally in six classifications, each of which defined the speed to be used under certain specified traffic conditions, with the final proviso that outside of business and residential districts, and unless otherwise limited by the act, speed would be limited to a maximum of forty-five miles per hour.

The original recommendations, as outlined above, were referred to a subcommittee of the conference for clarification and simplification. In presenting the gist of the arguments pro and con other provisions, to the subcommittee, Dr. Miller McClintock, chairman of the committee which had originally drafted the act, said:

"We are not entirely ready to eliminate all speed limits, neither do we recommend drastic curtailment, but the present recommendations are designed solely to be used as the basis for prosecutions."

The final action of the subcommittee reporting on speed limitations recommended the classification of restrictions into three groups, fifteen miles an hour, twenty-five miles an hour, and forty-five miles an hour, with speed under certain specified conditions limited to one of these classifications, and with forty-five miles an hour established as the maximum.

Article XV of the Uniform Act Regulating Traffic on Highways relating to equipment of the motor vehicle, carries at the end the following provisions: (Section 62) "It shall be unlawful for any person to sell or offer for sale, either separately or as a part of the equipment of a motor vehicle . . . . any electric headlamp or any auxiliary driving lamp, rear lamp or signal lamp, unless of a type which has been submitted to (the motor vehicle commissioner of the state) for test and for which a certificate of approval has been obtained from the (commissioner) as hereinafter provided."

The importance of headlighting requirements in the minds of those attending the conference may be gathered from the wording of the above paragraphs. A slight discrepancy between the recommendations of the Committee on the Maintenance of the Motor Vehicle, with regard to headlighting requirements and the language of the Uniform Act Regulating Traffic on Highways, in connection with the same subject,

provoked one of the bitterest controversies of the conference.

In outlining headlamp requirements, the Committee on Maintenance of the Motor Vehicle said:

"The lamps must be so aimed that the top of the beam is horizontal. The top of the upper beam, of the depressible beam equipment, should be horizontal when the car is empty. When the car is equipped with single-beam headlamps, the top of the beam should be horizontal when the car is loaded."

The permission to adjust the top of the upper beam of adjustable beam lighting equipment so that it would be horizontal when the car was empty, was seen by one group at the conference as permitting a loophole for operation with glaring headlights, in such cases as when the car should be loaded and the operator would not make proper use of the depressible beam equipment provided.

A joint committee of members of the Illuminating Engineers Society and the Society of Automotive Engineers had been appointed to study headlamp recommendations, with respect to both adjustment and permitted range of candlepower for bulbs. This committee recommended an increase in the present permitted candlepower, and cited figures to show that more night-driving accidents were caused by insufficient illumination of the road than by headlamp dazzle.

The sentiment of the conference, which seemed to be based on a psychological opposition to headlamp dazzle, or any provision which would leave a loophole for its legality, came to the surface with a summary rejection of the engineers' report on headlamp regulations, and the provision in the Uniform Act Regulating Traffic on Highways that headlamps would have to be adjusted so that no beam, at any time, would have its top above the horizontal.

Automotive men attending the conference included the following: R. J. Alden, Bendix Aviation Corp., Springfield, Mass.; Leon F. Banigan, editor, *Motor World Wholesale*, Philadelphia; David Beecroft, vice-president, Bendix Aviation Corp., New York; Major W. S. Bouton, Indian Motocycle Co., Springfield, Mass.; Norman Damon, Secretary, National Automobile Chamber, Washington; Leland W. Fox, Firestone Tire & Rubber Co., Akron; C. C. Hanch, Gen. Mgr., National Assn. Finance Companies, Chicago; Paul G. Hoffman, Vice-President Studebaker Corp. of America; J. R. Hunt, General Motors Corp., Detroit; C. J. Jolly, legal dept. General Motors Corp., Detroit; Lieut. Col. Frank S. Long, Indian Motocycle Co., Springfield; Edward F. Loomis, Sec., Truck Comm., National Auto Chamber; Joseph G. Myerson, Commercial Investment Trust, New York; W. C. Parker, Truck Comm., NACC; Alfred Reeves, Gen. Man. NACC, New York; Pierre Schon, General Motors Truck Co., and G. M. Sprowls, Goodyear Tire & Rubber Co.

Economic Volatility of Fuels Reported

(Continued from page 873)

perfectly at normal temperatures a very decided lag or "flat spot" develops at the instant of throttle opening when operating at vapor-locking temperatures. This is due to the same gas-lift action that occurred in the air-valve carbureter. In this case the fuel that is pumped from the jet lies in the bottom of the air passage and give a too rich mixture to be fired when the throttle is opened quickly.

Vapor locking places a very decided limit to the volatility of the fuel that the refiner dares to place on the market during the summer season. A lighter fuel would be easier to carburet and distribute uniformly in a multi-cylinder engine; it would be a cleaner-burning fuel, give better acceleration and have better antiknock properties.

The factors of design that most affect vapor lock are the placing of the carburetor, the location of fuel-feed lines and fuel-pumps or vacuum tanks, the hood and mud-pan design, the position of the exhaust pipe and finally, the air intake to the carburetor. Each of these details of design affects the temperature of the fuel in the carburetor and hence has a direct bearing on vapor lock.

There is another important advantage in locating the carburetor in a position where it will remain comparatively cool, and that is that the temperature range through which it will have to function is reduced. In one of the 21 cars on which tests were conducted the temperature of the fuel in the carburetor bowl never rose above 130 deg. Fahr. This car was one of the easiest to start, with small use of the choke at 9 deg. F., and its fuel economy was equal to that of any car.

The second paper on vapor lock was entitled "The Effect of Weathering on the Vapor-Locking Tendency of Gasolines," and was by Oscar C. Bridgeman, research associate, and Miss E. W. Aldrich, junior chemist, of the Bureau of Standards. The subject was investigated specially with relation to the effects of weathering on aircraft fuels.

Flight data obtained in airplanes climbing from the ground to altitude indicate that the temperature in the fuel tank remains considerably higher than the prevailing atmospheric temperature. Under these conditions of elevated temperature and reduced pressure, the fuel frequently boils in the tank with resultant decrease in the vapor-locking tendency. Boiling of the gasoline indicates that the vapor-locking temperature at the existing pressure has been reached and trouble may be expected, particularly in those fuel systems employing a fuel pump. However, if trouble from vapor lock does not occur before the fuel commences to boil in the tank, it is probable that the weathering will automatically prevent the occurrence of vapor lock after boiling starts.

The research work described and discussed was undertaken to determine the extent of weathering with a considerable number of gasolines under a variety of conditions and to evaluate the resultant change in the vapor-locking tendency of these fuels. The conclusion was reached that there is no appreciable change in the vapor-locking tendency over the short periods of time involved until the vapor pressure of the gas-free gasoline exceeds the prevailing atmospheric pressure. When this occurs, the practical limit to the amount of loss by weathering and the change in the tendency to cause trouble from vapor lock can be quantitatively estimated for any given temperature and atmospheric pressure.

Vapor Lock in Aircraft Engines May Come From Fuel Line Design

Installation of powerplant, with its accessories, requires more detailed attention than is given at present, Arthur Nutt declares at summer session of S. A. E.

TWO papers were presented at the Aircraft and Aircraft Engines session of the Society of Automotive Engineers summer meeting on May 28, the first by O. C. Bridgeman and H. S. White of the Bureau of Standards, entitled "Effect of Airplane Fuel Line Design on Vapor Lock," and the second by Arthur Nutt of the Curtiss-Wright Corp. on Aircraft Engine Installations, presented by Arthur Lake of the same company in Mr. Nutt's absence. Both papers formed virtually continuations of papers presented on these topics at previous S.A.E. meetings, some of the first paper having been presented at the St. Louis Aeronautical Meeting (see *Automotive Industries, March* 1) and the second at the Metropolitan Section Meeting (see *Automotive Industries*, April 19).

The work of Mr. Bridgeman and Mr. White has now progressed sufficiently so that definite recommendations as to fuel line design can be made, especially insofar as to what should be avoided.

An outstanding cause of vapor lock due to fuel line design, according to Mr. Bridgeman, will be found in fuel lines where there is a definite increase in diameter at some point. A restriction in the line at some point would also come under this category, since there must be an enlargement following a restriction. Reduction in pipe line sizes below the manifolding, for instance, does not seem to be a prime cause of vapor lock, according to the authors. Enlargements are so largely contributory to this phenomenon, however, that the temperature at which vapor lock is produced is well below the temperature calculated by derivation from the A.S.T.M. distillation curve 10 per cent point.

An interesting fact discovered by the authors is that the carburetor float bowl automatically tends to prevent vapor lock in the carburetor ascribed to the building up of pressure in the float chamber following the collecting of vapors above the level of the liquid. This phenomenon is held accountable for the curious form of the temperature-flow curve shown in Fig. 1, where an incipient vapor lock is in evidence, but in which further increases in temperature actually indicate an increased flow and enriching of the mixture.

Fig. 2 shows that, when the vent is enlarged, the vapor-locking tendency more nearly approaches the theoretical derived by calculation of temperature, and further indicates that the assumption mentioned above seems to be correct. It also allows for the assumption that proper design of the carburetor vent size might enable the provision of a carburetor which would neither tend to enrich nor lean out the mixture ratio at temperatures considerably in excess of that sufficient, under normal conditions, to produce vapor lock—at least within reasonable operating mixture ratios.

In the discussion it was brought out that many airplanes are capable, due to their design, of providing a sufficient gravity head to build up a pressure high enough to correspond with the requirements of some carburetors, and that some airplanes are actually being operated on a negative head. F. W. Heckert, of Wright Field, stated that the army is working on a

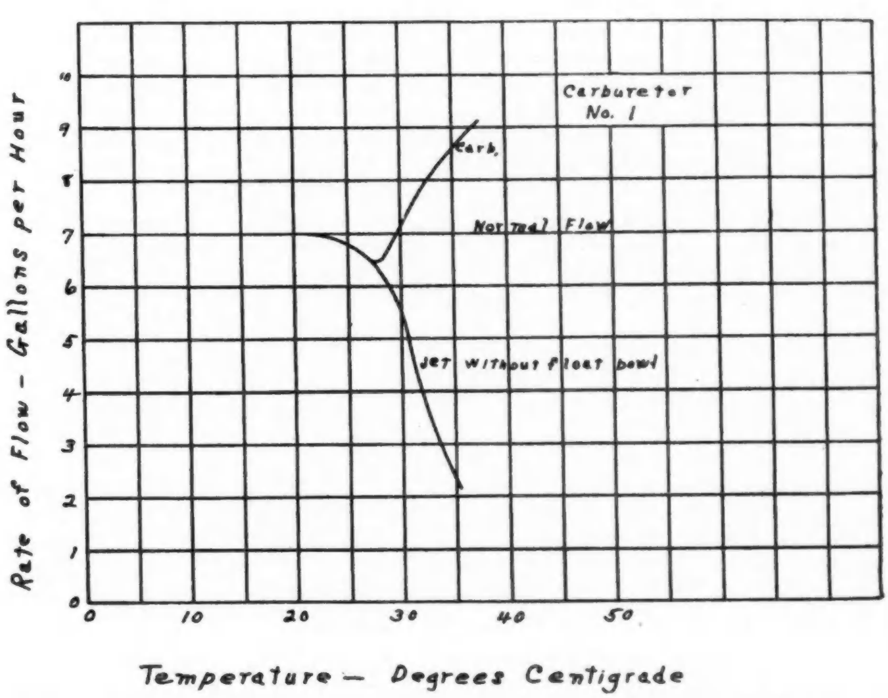


Fig. 1—Temperature-flow curve, where an incipient vapor-lock is in evidence, but in which further increases in temperature indicate richer mixture

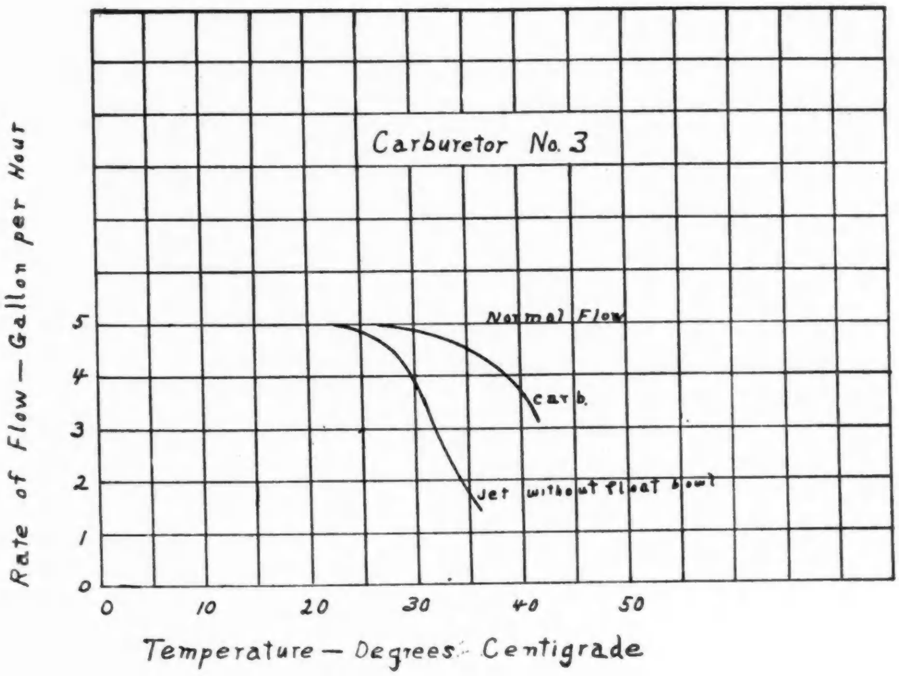


Fig. 2 — Temperature - flow curve. Vapor locking tendency approaches theoretical derived by calculation of temperature

pump which they consider much superior to the C-5 unit, due to the reduction of suction built up in the C-5 pump by its rotating members, and its tendency to produce vapor lock ahead of the pump.

A suggestion for vacuum feed systems was made by Mr. Bridgeman, who attributed the idea to Mr. White, his co-author. To reduce vapor locking tendency he suggested that the outlet to the carburetor be in the form of a cone, quite large at the upper end and tapering off into a ¾ in. or similar tubing, leading to the carburetor.

Mr. Nutt's paper further confirmed the necessity of paying more attention to the fuel feed installation in an airplane. Mr. Nutt stating in his paper that he had encountered the same conditions of actual negative head in gravity feed systems. However, Mr. Nutt was of the opinion that gravity systems should be used wherever possible, to simplify the installation and reduce some of the potential sources of trouble.

As a matter of fact there was not a single item connected with the installation of an engine in an airplane, connection of controls, and location of accessories, cowling, etc., which Mr. Nutt felt was given on the average the attention which should be accorded to it. Especially emphasized by Mr. Nutt, and corroborated by Mr. Heckert in the discussion, was the matter of oil temperature indicating and control devices. Mr. Nutt stated in his paper engine oil temperatures frequently reach figures in excess of 250 deg. Fahr. and that the only reason pilots fly some ships is that they have no idea that the temperature at the outlet reaches such a dangerous figure. Mr. Nutt recommended that oil thermometers be installed to enable readings of either or both inlet and outlet oil.

Ethyl fluid in gasoline also seems to have caused considerable trouble in manifolding, according to Mr. Nutt, who stated that it appears that special materials which will not be attacked by tetraethyl lead appear to be required for manifolding. Carburetor heating also seems to be little understood according to Mr. Nutt, who contends that a properly designed system requires only part of the exhaust from a single cylinder. Such a design, of course, would reduce the amount of heat in the engine compartment to a minimum, and help the oil temperature situation materially.

There was some discussion following the paper as to whether carburetor heat should be applied to the air ahead of the intake, or in the form of a hot-spot in the riser. Proponents of the first method contended that it helped to reduce tendency to form ice, while the latter group pointed out the advantage gained by improving distribution. No one suggested that both methods be used, curiously enough.

Pierce-Arrow Announces New Straight Eight

PIERCE-ARROW is holding nation-wide showings this week of its new model C Straight Eights, announced as a companion car to the two groups of larger models introduced earlier this year. The new cars are priced at the lowest levels in years, ranging from $2,695 to $2,875 at Buffalo.

The new models closely resemble the larger and higher-priced cars, being distinguished by the Pierce-Arrow fender lamps. The wheelbase is 132 in.

The engine produces 115 hp. A new dual carburetor and improvements in manifolding account partly for improved performance. A new transmission which is capable of remarkable traffic acceleration is used. A nine-bearing balanced crankshaft is mounted in diamond-bored bearings.

As in all Pierce-Arrow cars, safety glass is used for the windshield and all windows throughout. The interiors of the cars are typically Pierce-Arrow. The cushions are luxurious, the rear one in the Sedan and Brougham having great depth because of the manner in which the car frame rises and then drops over the rear axle.

Stainless steel is used in more than 300 parts of the new cars, even for small bolts, nuts and washers.

Frictionless ball-bearing spring shackles, powerful four-wheel safety brakes, distinctive hub caps, hydraulic shock absorbers, heavier front and rear bumpers, inside sun visors, are among the list of equipment items.

Three body types of Model C are available—a 5-passenger sedan, a 5-passenger brougham and a 2-passenger coupe. Pierce-Arrow's complete line of new models now comprises eighteen body styles offered on 132, 134, 139 and 144-in. wheelbases with three types of eight-cylinder engines ranging up to 132 hp.

Diesel Engined Automobiles Said to Be Within Sight

C. L. Cummins, manufacturer of six-cylinder plant, expects installation dimensions comparable with those of present standard gasoline types + +

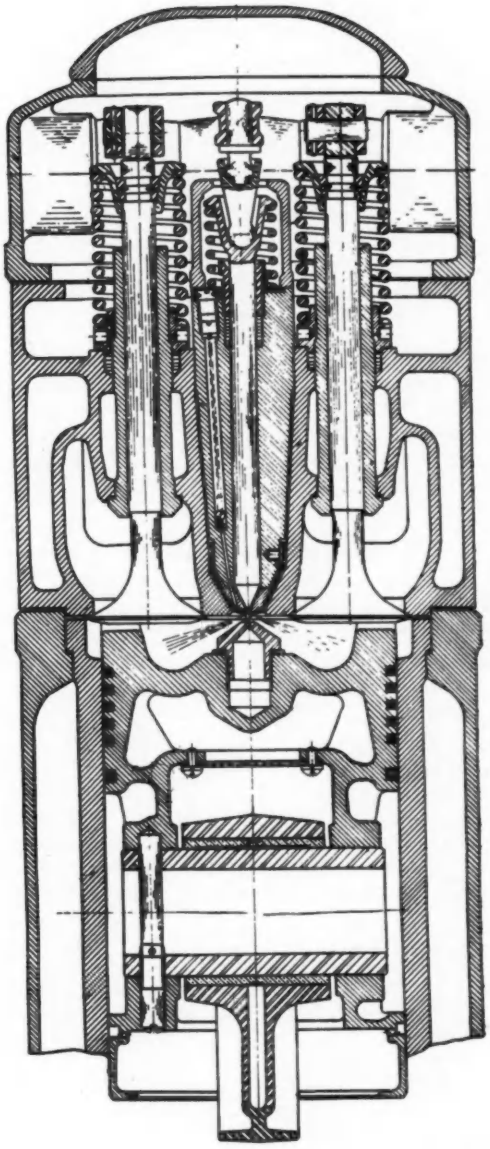


Fig. 1—Actual construction diagram, in section, of the Cummins cylinder head, injector, etc.

NO session of the S.A.E. summer meeting at French Lick created more interest than that devoted to Diesel engines, at which A. J. Poole of the Robert Bosch Company presided. The first paper, on "Small Diesel Engines," by H. D. Hill of the Hill Diesel Engine Co., Lansing, Mich., contained a few general remarks on the subject and then launched into a description, accompanied by sectional and photographic illustrations, of the author's high-speed Diesel engine, which is of the ante-chamber type. One feature that distinguishes it from other engines of the same type is that the outlet from the ante-chamber is a drill-hole of considerable size, as a result of which the pressures in the ante-chamber and the combustion chamber are nearly alike except during the period of injection. The entire volume of air in the ante-chamber is charged with fuel, and combustion proceeds until the air is consumed, leaving the chamber filled with a rich mixture of spent air and fuel, most of which will be forced out by the pressure rise due to the pre-combustion. If the mixture in the ante-chamber is forced out through several small holes (as in other designs), any flame in the ante-chamber becomes extinguished, by the principle of the miner's safety lamp, and combustion must be restarted in the cylinder.

The second paper, "Diesel Engines for Automobiles," by C. L. Cummins, of Columbus, Ind., was an account of Mr. Cummins' demonstration last winter of a number of passenger cars equipped with Diesel engines, in an overland trip to the New York automobile show and at Daytona Beach. The details of this demonstration are known to our readers, but a few additional particulars of the engine used, as given in Mr. Cummins' paper, may be of interest.

Experience in Metering Fuel

Earlier experience had convinced the author that metering and injection of the fuel should be completely separated, for when they are combined, pressures of 3000 to 5000 lb. p. sq. in. are required in the system, and these preclude the accurate metering of the small quantities of fuel required per cycle when running throttled. If the two functions are separated the metering and delivery of the charge is accomplished as the first stage, under very low pressure, with satisfactory accuracy.

The fuel metering system on the six-cylinder engine used in the demonstrating cars is shown in Fig. 2. A plunger common to all cylinders is used, and has a fixed displacement. A linkage opens the fuel inlet valve, holding it open during the whole of the inlet stroke and during a portion of the delivery stroke; it closes at the moment when the amount of fuel left in the pump barrel is just sufficient for the charge under the momentary conditions of operation. The mechanism then allows the fuel inlet valve to close, and the fuel remaining in the pump barrel is forced out through the delivery valve to the injector. With this construction, all influence of engine speed on the fuel delivered per cycle is eliminated, and overcharging of the cylinder due to pulling down of the engine speed by overload becomes impossible. There remains, however, the problem of synchronizing the various plungers and valve mechanism, so that each cylinder gets exactly the same amount of fuel. The mechanism employed is shown diagrammatically in Fig. 3.

Fuel is drawn from the tank by gear pump *A*, which, through a pressure regulator, maintains a constant

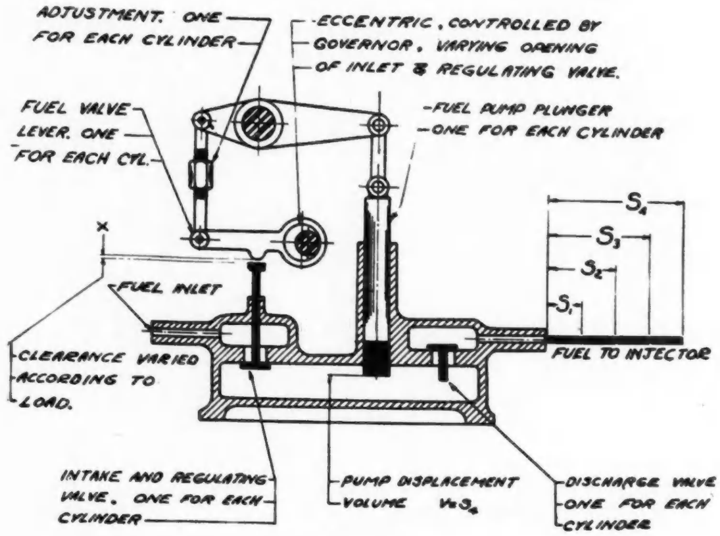


Fig. 2—Fuel metering system of the Cummins Diesel engine

pressure on the line to the fuel distributor. *C* is the distributor disk, in which the ports are so indexed that pressure from the gear pump line is in circuit with the common plunger for all cylinders. As the fuel is under pressure, the plunger chamber is always completely filled with fuel, regardless of speed. The indexing of the disk is such that as the plunger is retracted, the fuel is admitted, and as the plunger is advanced on the discharge stroke, the disk is revolved to bring into the circuit ports which carry the fuel to each injector in proper sequence.

Suction Valve Timing Varied

The metering or measuring of the charge is controlled by varying the effective stroke of the plunger. This is accomplished by swinging the link from the zero point on the lever out sufficiently far to give the plunger sufficient displacement for maximum charge of fuel. This link is controlled by an eccentric on which there are no adjustments, the maximum throw of the eccentric being figured to swing the lever just far enough to give the desired results.

Interesting means are provided for adding to the turbulence in the combustion chamber during the power stroke. The piston has a small bottle with open nozzle leading to the combustion chamber. During the compression stroke the bottle, being in communication with the combustion chamber, fills with pure air at a pressure equal to that in the compression chamber. After injection has taken place and the piston starts on the working stroke, the pressure in the working chamber drops and a clean charge of air is forced through the outlet of the bottle into the zone of most intense combustion. Mr. Cummins states that this breaks up the flame and also blasts off any incrustation that may form on the end of the injector.

The actual construction is shown in Fig. 1. The "bottle" is in the form of a small stainless steel thimble which is screwed into the center boss on the piston head. When the piston is at the upper end of the stroke the thimble is close to the end of the injector, but by the time the piston has covered ¼ in. of the working stroke the pressure in the combustion chamber has decreased 150 lb. p. sq. in., hence the bottle can be very effective.

Additional turbulence is produced by the form of the piston head, which is flat near its circumference, this flat portion coming very close to the under surface of the cylinder head when the piston is at the top end of the stroke. This forces the air from the circumference of the cylinder toward the center.

In concluding Mr. Cummins said he was now designing an engine that will have installation dimensions comparable with those of present-day standard gasoline engines in truck and bus service, and he felt that the fuel economy possible, elimination of the fire hazard, the high-torque-at-low-speed characteristic and the ability to start at low temperatures and carry load instantly should carry the Diesel engine into the automotive field in the very near future.

In the discussion A. Ludlow Clayden of the Sun Oil Company said every time the automotive Diesel engine was mentioned in the public press mention was made also of the cheapness of the fuel it burned. It was a mistake to believe that fuel suitable for Diesels would be available at 5 to 6 cents a gallon if this type of engine really came into wide use. The present low price of this fuel was due to overproduction. There was less fuel available for Diesel engines than there was gasoline. Mr. Clayden mentioned that a committee of the A.S.M.E. was endeavoring to standardize specifications for Diesel fuel oil and would like to learn from engine builders what maximum viscosity limit should be set. There was no use specifying the minimum Baume reading, because the viscosity was what counted and for a given degree Baume the viscosity varied with the base.

Another point that had come up in the deliberations of this committee was whether any lubricating ele-

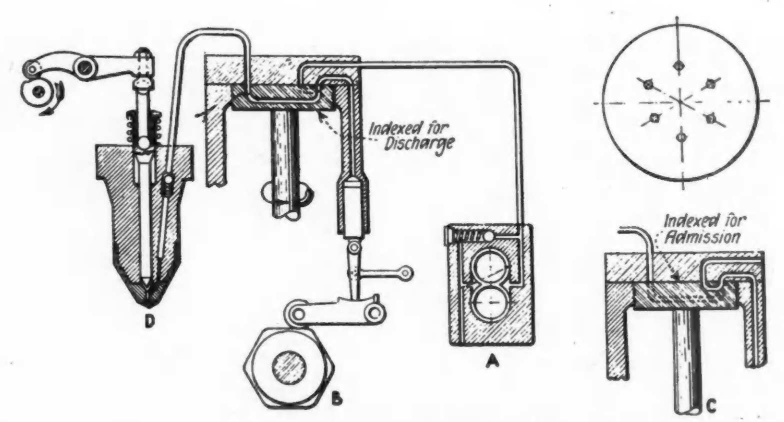


Fig. 3—Diagram of the Cummins Diesel engine fuel supply system

ments should be introduced in the fuel. This had been found very desirable in the case of fuel oils for large marine Diesel engines, but, of course, it would add to the cost. Edward D. Herrick, chief engineer of Lycoming, indorsed Mr. Clayden's remarks and asked Mr. Hill whether he filtered his fuel. Mr. Hill answered that it is a very great advantage to have the oil filtered. Any commercial filter can be used, but a centrifugal purifier is better. If the fuel drops below 24 deg. Baume it must be heated, but such fuel would hardly be used for automotive purposes. As regards sources of fuel, he had been told by oil men that only 10 per cent of the gasoline now marketed was produced from crude oil directly by distillation, the rest being produced by cracking fuel oils, and if all oil were used in Diesels the cost of cracking could be saved.

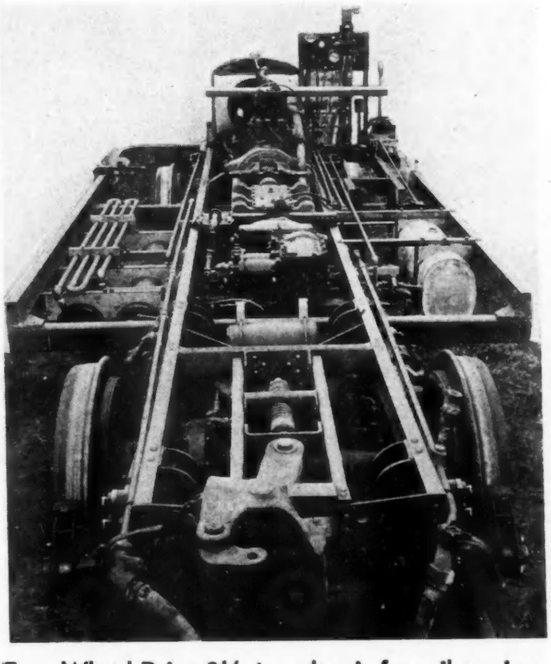
A lot of questions bearing on Diesel engine design and operation were fired at the two authors, and most of them were answered by Mr. Cummins. The latter said he believed the advent of the automotive Diesel engine was not far off. He believed it would weigh not to exceed 10 per cent more than an equivalent gasoline engine, and in real quality production the cost would exceed that of the gasoline engine by from 10 to 15 per cent. As regards acceleration the car he had built for the demonstrations could out-perform practically all stock gasoline cars.

Mr. Cummins also referred to the fuel problem and said that if there was any difficulty in getting suitable fuel in sufficient quantity from the refiners, the Diesel engine industry could get its fuel directly from the producers, as the engine would run satisfactorily on crude oil. They had had a shipment of crude oil directly from a southern oil field and it had given very satisfactory results. Of course, not every kind of crude oil could be used in this way.

FWD Develops Railcar

IT will be remembered by those whose experience in the automobile business extends back some fifteen years that the first gasoline-powered units used on rail lines were converted trucks. Later the regular rail car was developed and the use of trucks on rails came to an end in this country, but there is still a demand for such converted vehicles abroad. The illustration herewith shows an intermediate type of vehicle developed by the Four Wheel Drive Auto Company of Clintonville, Wis., and consists essentially of that firm's 3½-ton chassis with special equipment adapting it for use on rails. One would expect the four-wheel drive to be particularly adapted for rail service, as it makes the entire weight of the vehicle and load available for traction purposes, and it stands to reason that, owing to the much smaller adhesion between a steel tire and a steel rail than between a rubber tire and a hard-surfaced road, this additional traction is required, especially when accelerating in low gear with a trailer load.

The frame, which is made of 0.156 in. pressed steel and comprises side rails of channel section 5 3/16 in. deep, is supported on railroad-type shackle springs. The axles carry the conventional railroad-type flanged wheels, to which the Westinghouse shoe-type air brakes are applied.



Four Wheel Drive 3½-ton chassis for rail service

The engine is a six-cylinder Waukesha and develops 87 hp. at 2000 r.p.m. The transmission gives four forward and four reverse speeds, forward and reverse speeds being equal, hence the car can be run at the same speed in both directions. With a gear ratio of 5.65 to 1 a maximum speed of 35 m.p.h. is obtainable.

Reliability at Indianapolis

(Continued from Page 872)

struction, the Jones Stutz was a stock chassis, the body differing only slightly from the standard two-passenger speedster model. The duPont, which was running well up to the time that it hit the wall, is of a model that is regularly offered for sale by the manufacturers. Save for the body, use of ball bearings at the outer ends of the rear axle housing, double manifolds and aluminum pistons, the V-eight, a car running well at the finish, was an Oakland 1930 stock chassis. The Romthe eight, built by Studebaker test department personnel in their spare time, was constructed entirely, except the body and wheels, from stock Studebaker parts. This car was handled well and performed consistently, but was eliminated late in the race due to failure of the gasoline tank.

One of the best-handled cars in the race was also the least expensive to build. This was the Fronty Special, which except for the head and body and engine accessories, was built by Arthur Chevrolet from model T and model A Ford parts. This car qualified at 97-plus m.p.h.

Although the writer believes that the semi-stock cars may place in the money in an event where prizes are awarded up to tenth place, it is his belief that the specially-built creations, of which those turned out by Harry Miller and the Duesenberg Brothers are but a type, will garner most of the first-prize purses. This belief is based on the assumption that the new rules affect experienced race car builders only in as much as they must design and build to a new set of specifications. The best of materials and the finest workmanship will always be a prime requisite for a successful race car.

Automotive Oddities by Pete Keenan